A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

OCTOBER, 1937.

GENERAL PHYSICS.

ADSORPTION.

4229. Quantitative Separation of Neon and Helium. K. Peters. *Zeits. f. phys. Chem.* 180. *Abt.A.* 1. *pp.* 44–50, 1937.—The quantitative separation of the inert gases is described. It has been found that only below −225° C. can Ne be quantitatively adsorbed from a mixture of Ne and He, while He can only be pumped quantitatively from active charcoal in a pure condition at this temperature. This separation is suitable for use as a lecture experiment to demonstrate the quantitative separation and purification of gases by the desorption method. Full experimental details are given. H. H. Ho.

4230. Sorption of Gases and Molecular Structure. K. Peters and W. Lohmar. *Zeits. f. phys. Chem.* 180. *Abt.A.* 1. *pp.* 58–78, 1937.—The adsorption isotherms for the inert gases and CH_4 in the log a/log p diagram possess a rectilinear character, but this simple relationship between gas pressure and amount of adsorbed gas does not hold for ethane, propane, *n*-butane and isobutane, and moreover the adsorption procedure is not reversible. Desorption isotherms are obtained by transition from higher to lower pressures over the adsorbent, which at the lower pressures lie like the corresponding adsorption isotherms, a phenomenon, which stands in direct relationship with the molecular structure of the gas. Full experimental details are given. H. H. Ho.

4231. Corresponding States of Gas Adsorption. K. Peters. *Zeits. f. phys. Chem.* 180. *Abt.A.* 1. *pp.* 79–91, 1937.—It is established that for corresponding states of gases the temperature and pressure dependence of the adsorption is identical for the different inert gases. H. H. Ho.

4232. Adsorption on Gels. Part II. K. S. Rao and B. S. Rao. *Indian Acad. Sci., Proc.* 6*A*. *pp.* 16–23, *July*, 1937.—A microspring balance of quartz fibre of the McBain-Bakr type is used for studying adsorption of vapours of water and pyridine on gels of silica and alumina. The difference in adsorption on "glassy" and "chalky" gels of silica is accounted for, by the wider capillaries in the latter. Adsorption of pyridine on alumina gels activated at 400°, 500° and 850° C. is studied. The differences noticed are attributed to the variation in capillary size. [For Part I see Abstract 410 (1937).] AUTHORS.

4233. Selective Adsorption on Silica Gel from Pyridine-Alcohol Mixtures. N. Venkatanarasimhachar and K. S. G. Doss. *Indian Acad. Sci., Proc.* 6*A*. *pp.* 32–35, *July*, 1937.—Refractive indices of pyridine-ethyl alcohol mixtures are measured at 23·37° C. and the selective adsorption on silica gel from them is measured over the entire range of concentration. The selectivity concentration curve is found to be of the S-type. Evidence is adduced to show that an adsorption compound $C_5H_5N,2EtOH$ is formed at the interface. [See also Abstract 919 (1936).] AUTHORS.

4234. Contact Potentials: Condensation of K and Na on W. R. C. L. Bosworth and E. K. Rideal. *Roy. Soc., Proc.* 162*A*. *pp.* 1–31, *Sept.* 1, 1937.—Wires of extremely clean W, WO, or WH, are covered to varying extent by Na or K, and the contact potential is measured. From the reduction of the work function it is possible to calculate the dipole moment of the adsorbed ions. This depends on the number of adsorbed ions and is a maximum when there are very few. This value is independent of the nature of the base, but the reduction upon increasing degree of covering depends on the base. H_2 will not be adsorbed in those sites in which there are adsorbed K or Na ions. If a ribbon is used instead of a wire, conditions are more complicated, presumably owing to a very great effective surface. [See following Abstract.] R. P.

4235. Contact Potentials. Evaporation of Sodium Films. R. C. L. Bosworth. *Roy. Soc., Proc.* 162*A*. *pp.* 32–49, *Sept.* 1, 1937.—It is found that upon heating a filament carrying a film of adsorbed Na the atoms may first get into excited states, thereby reducing their dipole moment, and then finally evaporate from the surface. The dependence of the rate of evaporation on the density of adsorbed atoms and on temperature is studied. The results are discussed and it is deduced that concentrated films will have the tendency to split up into a condensed and a diffuse phase. [See preceding Abstract.] R. P.

See also Abstracts 4252, 4270, 4370, 4372, 4606.

ATOMIC AND MOLECULAR STRUCTURE.

4236. Model of Atomic Nuclei. F. J. v. Wiśniewski. *Acta Physica Polonica*, 6. 2. *pp.* 125–129, 1937. *In German.*—It is assumed that a number of elementary particles are evenly spread on a circle which rotates about a fixed centre. With the exception of the nuclei of weight 3 there is one further particle in the centre. The interaction force between any two particles is assumed to follow an inverse fourth power law, while the radius of the circle is assumed to be proportional to the square root of the number of particles it contains, except for the case of weight 3 for which $\sqrt{3}$ is replaced by $\sqrt{2}$. The equilibrium of this configuration is not investigated. The energies agree approximately with the observed mass defects up to the weight 12. R. P.

4237. Binding Energies of Atomic Nuclei. Part II. T. Yamanouchi. *Phys. Math. Soc. Japan, Proc.* 19. *pp.* 790–797, *Aug.*, 1937. *In English.*—The theory of the author [see Abstract 3794 (1937)] is extended so as to include the mass difference between proton and neutron. The formulæ obtained in this way contain a number of parameters which cannot be easily calculated, but by eliminating these parameters relations between the mass defects of different nuclei are obtained which are in satisfactory agreement with experiment. R. P.

4238. Theory of the Deuteron. T. Kahan. *J. de Physique et le Radium*, 8. *pp.* 281–284, *July*, 1937.—The wave equation of the deuteron regarded as proton + neutron, is determined. This equation is discussed leading up to the result previously obtained as to proton-neutron interaction. [See Abstract 1870 (1937).] C. A. S.

4239. Relativistic Effects for the Deuteron. S. Share and G. Breit. *Phys. Rev.* 52. *pp.* 546–551, *Sept.* 15, 1937.—It is seen from tables and equations given that an appreciable spin-spin dependence of the neutron-proton interaction can be expected to arise. This spin dependence is of the wrong sign to account for the empirically known difference in energies of the singlet and triplet states of the deuteron. Its presence suggests that the spatial dependence of spin-dependent forces is not wholly the same as that of the other forces. The possibility of finding a simple equation in which the empirical spin dependence will be a natural consequence is still open. It is shown that the relativistic correction to the kinetic energy is only a small part of the corrections called for by invariance. The relativistic refinements made so far in the combined theory of H^2 and H^3 are shown to be questionable from this point of view, as well as on account of the possible presence of terms in relative momenta which are not determined by requirements of invariance alone. AUTHORS.

4240. Comparison of Proton-Proton and Proton-Neutron Interactions. G. Breit and J. R. Stehn. *Phys. Rev.* 52. *pp.* 396–399, *Sept.* 1, 1937.—Based on the data of Tuve, Heydenburg and Hafstad for the scattering of protons by protons and that of Amaldi and Fermi for the scattering of neutrons by protons a comparison of the two interactions is made. The present comparison is made more accurately than previously and allows for the uncertainty in the chemical factor C which is used in the interpretation of the neutron-proton experiments. The results are substantially in agreement with those of Breit, Condon and Present [see Abstract 5329 (1936)], the two interactions being very nearly equal. A slight excess of neutron-proton attraction over that between protons is indicated by the present calculation. Fermi's conclusion that the singlet S level of deuterium is virtual is re-examined by taking into account the effect of the range of force and of the chemical factor on the mean life of neutrons in an atmosphere of protons. Experiment agrees better with a virtual than with a real level. Nevertheless the evidence for its virtual character is not so good as to exclude completely the possibility that it is real. Tests by means of which a real level could be found if present are discussed. AUTHORS.

4241. Theory of Scattering of Protons by Protons. A. S. Eddington. *Roy. Soc., Proc.* 162*A*. *pp.* 155–174, *Sept.* 15, 1937.—The combination of relativity theory and quantum theory developed in "Relativity Theory of Protons and Electrons" is applied to the problem of close encounters of two protons. It is pointed out that the system of two protons, unlike a neutral system, cannot be treated as simply superposed on the rest of the universe without disturbing it. The disturbance is taken into account, and found to give an extra energy term in the wave equation of amount $-\mathrm{A}e^{-r^2/k_0^2}$, the constants being $k_0 = \mathrm{R}/\sqrt{\mathrm{N}} = 2{\cdot}20 \times 10^{-13}$ cm., $\mathrm{A} = 4m_p\epsilon^2/\sqrt{\pi}m_0k_0 = 39{\cdot}2m_ec^2$, where R is the Einstein radius and N the number of particles in the universe, m_p the greater root of $10m^2 - 136mm_0 + m_0^2 = 0$, and ϵ the electronic charge. The values agree with those derived from the observed scattering by Breit, Condon and Present [see Abstract 5329 (1936)]. AUTHOR.

4242. Artificial Radioactivity at Low Potentials. E. Bertl, F. Obořil and K. Sitte. *Zeits. f. Physik*, 106. 7–8. *pp.* 463–473, 1937.—With applied potentials of only about 25 kV, the neutrons produced by the bombardment of Be by deuteron canal rays, are used to produce artificial radioactivity in Ag and Rh. The excitation differs considerably from the theoretical Gamow curve. The explanation seems to lie in the assumption of a larger effective absorptive cross-section for the neutrons than has hitherto been assumed. F. C. C.

4243. Radioactivity Produced by High-Energy Neutron Bombardment. M. L. Pool, J. M. Cork and R. L. Thornton. *Phys. Rev.* 52. *pp.* 239–240, *Aug.* 1, 1937.—By the bombardment of 61 of the stable elements with neutrons of energies up to 20 eMV (those of higher energy being obtained by bombarding Li in the cyclotron with 6·3 eMV deuterons) 113 products were obtained of each of which the period, sign and probable nature are given. The only element from among these which failed to give measurable radioactivity is Bi. C. A. S.

4244. Neutron-Induced Radioactivity of Noble Metals. E. McMillan, M. Kamen and S. Ruben. *Phys. Rev.* 52. *pp.* 375–377, *Aug.* 15, 1937.—Preliminary results are given of experiments in which elements in the neighbourhood of Pt are bombarded with neutrons. The elements are Hg, Au, Ir and Pt, in the order of increasing complexity of the results. No simple explanation of the results seems possible. G. O. B.

4245. Angular Distribution of the Products of Disintegration of Light Elements by Hydrogen Ions. Part II. H. Neuert. *Phys. Zeits.* 38. *pp.* 618–622, *Aug.* 15, 1937.—Continuing previous work [see Abstract 1407 (1937)], the angular distribution of the α-particles emitted in the disintegration $B^{11}_{5}(p : \alpha)Be^{8}_{4}$ is examined. About twice as many α-particles are emitted at 20° to the incident beam as are emitted at 90° to that direction. In the disintegration $B^{11}_{5}(p : \alpha,\alpha)\alpha$ the emitted α-particles with range greater than 20 mm. also showed a distinct variation with angle over the range 20° to 110°. On the other hand, no angular variation of emission was found for the disintegration $Li^{6}_{3}(p : \alpha)He^{3}_{2}$ over a range 90° to 150°. F. C. C.

4246. Disintegration of Lithium by Deuterons. J. H. Williams, W. G. Shepherd and R. O. Haxby. *Phys. Rev.* 52. *pp.* 390–396, *Sept.* 1, 1937.—The following disintegrations have been studied in the range of deuteron energy from 100 to 250 kV :

$$_{3}Li^{7} + {}_{1}H^{2} \rightarrow {}_{2}He^{4} + {}_{2}He^{4} + {}_{0}n^{1} + Q_{1} \quad (1)$$

$$_{3}Li^{6} + {}_{1}H^{2} \rightarrow {}_{2}He^{4} + {}_{2}He^{4} + Q_{2} \quad (2)$$

$$_{3}Li^{6} + {}_{1}H^{2} \rightarrow {}_{3}Li^{7} + {}_{1}H^{1} + Q_{3a} \quad (3a)$$

$$_{3}Li^{6} + {}_{1}H^{2} \rightarrow {}_{3}Li^{7*} + {}_{1}H^{1} + Q_{3b} \quad (3b)$$

$$_{3}Li^{7*} \rightarrow {}_{3}Li^{7} + h\nu$$

$$_{3}Li^{7} + {}_{1}H^{2} \rightarrow {}_{2}He^{5} + {}_{2}He^{4} + Q_{4} \quad (4)$$

Efficiency curves for (1), (2) and (3a) are regular. It is concluded that the Oppenheimer-Phillips process is not applicable to (3a). The relative yield of (3b) to (3a) increases with increasing deuteron energy. The return of the excited Li nucleus in (3b) to its normal state is shown by the emission of a gamma-ray of 400 kV energy as determined by absorption measurements. The existence of a homogeneous group of particles from (4) is interpreted as evidence for the instability of He^{5}, which has a mean life of approximately 6×10^{-20} sec. and is unstable by 0·93 eMV, disintegrating into an α-particle and a neutron. Absolute yields for the five disintegrations studied are given for a deuteron energy of 212 kV. AUTHORS.

4247. Nuclear Transformations Produced in Copper by α-Particle Bombardment. W. B. Mann. *Phys. Rev.* 52. *pp.* 405–407, *Sept.* 1, 1937.—The radioactivity produced by bombardment of Cu with 11 eMV α-particles has been investigated. Activities having half-lives of 1·10 ± 0·05 hr. and 9·2 ± 0·2 hr. have been found to belong, respectively, to the radioactive isotopes Ga^{68} and Ga^{66}. Both these isotopes have been found to be positron active. Absorption measurements gave values of respectively 1·8 and 3·1 eMV for the maximum energies of the short and long period positrons. Measurements of the positron tracks photographed in a cloud chamber gave, however, corresponding values of 1·9 and 3·9 eMV. The excitation function for α-particles and Cu has also been investigated. AUTHOR.

4248. Radioactive Isotopes of Scandium from Calcium and Potassium by α-Particle Bombardment. H. Walke. *Phys. Rev.* 52. *pp.* 400–404, *Sept.* 1, 1937.—A study has been made of the radioactive isotopes of Sc formed from Ca and K by bombardment with α-particles. Sc^{43} has been separated chemically from Ca, its half-life being 4·0 ± 0·1 hr. No evidence has been obtained of Sc^{46} or Sc^{47}. Two radioactive isotopes of Sc, *viz*. Sc^{42} and Sc^{44}, have been isolated from K, these having half-lives of 4·1 ± 0·1 hr. and 52 ± 3 hr., respectively. Cloud chamber studies of the positrons emitted by Sc^{43} and Sc^{42} show that the upper limits of the two spectra are 1·3 (8) and 1·6 (3) eMV, respectively.
AUTHOR.

4249. Radioactive Isotopes of Indium. J. L. Lawson and J. M. Cork. *Phys. Rev.* 52. *pp.* 531–535, *Sept.* 15, 1937.—Although there are but two stable isotopes of In whose mass numbers are 113 and 115, seven radioactive periods are shown to exist. Six of these whose half-life periods are 13 sec., 72 sec., 54 min., 2·3 hr., 4·1 hr. and 50 days emit negative electrons, and one period of 20 min. is radiopositive. By bombarding In with slow neutrons, deuterons and very fast neutrons, and by bombarding Cd with deuterons it is possible to assign with considerable confidence each period to a certain In isotope. The conclusions are that the 54 min. and 13 sec. activities are both due to In^{116}, the 4·1 hr. and 50-day periods are both In^{114} and the 20-min., 72-sec. and 2·3-hr. periods are from isotopes of mass 111, 112, and 117, respectively. β-ray energy limits are approximately 2·15 eMV for the 50-day period and 1·75 eMV for the 20-min. positive period. AUTHORS.

4250. Long-Period Positron Activity: Na^{22}. L. J. Laslett. *Phys. Rev.* 52. *pp.* 529–530, *Sept.* 15, 1937.—The bombardment of Mg with 5·2 eMV deuterons was found to result in a long-period radioactivity ascribable to Na^{22}. The half-line, as determined from measurements extending over a period of a year, is 3·0 ± 0·2 years. Absorption measurements on the positrons emitted agree with similar measurements made with a F sample subjected to α-particle bombardment; the positron momentum distribution was investigated with a He-filled cloud chamber in a magnetic field, an upper limit being found at a value corresponding to 0·58 ± 0·03 eMV. AUTHOR.

4251. γ-Radiation from Li and F Bombarded with Protons. E. R. Gaerttner and H. R. Crane. *Phys. Rev.* 52. *pp.* 582–591, *Sept.* 15, 1937.—The recoil electrons ejected from a 2 mm. carbon scatterer by the γ-radiation from $Li + H^1$ have been investigated and indicate three lines of energies 17, 14·5 and 11·5 and possibly a fourth line of energy 8·5 eMV. Pairs ejected from the same scatterer were also observed. Most of these may be attributed to the 17 eMV line. Recoil electrons ejected from a 1·5 mm. carbon scatterer by the γ-radiation from $F + H^1$ have been observed, and indicate two lines of energies 5·7 and 4 eMV. Pairs produced by internal conversion of the γ-radiation from $F + H^1$ were also observed, and indicate the same two lines. The cross-section for this effect is in good agreement with the theoretical predictions. It is pointed out that a study of the pairs produced by internal conversion affords an excellent method of determining excitation levels in nuclei.
AUTHORS.

4252. Separation of Hydrogen Isotopes by Fractional Desorption. K. Peters and W. Lohmar. *Zeits. f. phys. Chem.* 180. *Abt.A.* 1. *pp.* 51–57, 1937.—It is shown from experiments on the separation of

H and D, that the method of fractional desorption *in vacuo* with correct choice of temperature is more efficient than all the other known methods of isotope separation. The following three conditions must be fulfilled for a quantitative separation of any given gaseous mixture: (1) The separation temperature must lie below the critical adsorption temperature of the less volatile and above that of the more volatile gas. (2) The desorption has to be performed in as high a vacuum as possible. (3) The adsorbent employed must be of such amount that the adsorbed gas does not cover more than about 10% of the surface; each gramme of active charcoal will adsorb about 50 cc. of gas. Deviation from these conditions causes a decrease in the separation efficiency. H. H. Ho.

4253. Separation of Isotopes. J. Bernamont and M. Magat. *Comptes Rendus*, 205. *pp*. 367–368, *Aug*. 9, 1937.—An intense beam of positive ions of the isotopes to be separated, produced at low potential, is passed into a chamber perpendicularly to its parallel walls P_1, P_2, which are maintained at a p.d. of V; in the more distant wall, P_2, there is an opening into a second similar chamber between the parallel walls of which P_2, P_3, a h.f. alternating p.d. is maintained. Just beyond a quite similar opening in P_3 is a plate maintained at a negative potential E, less in absolute value than V, on which one of the isotopes collects. Calculation (not given) shows that by suitable adjustment of the potentials one isotope alone can be collected, and that the required potentials are quite realisable. C. A. S.

4254. Search for H^3 and He^3. (Lord) Rutherford. *Nature*, 140. *pp*. 303–305, *Aug*. 21, 1937.—A survey of the many investigations made to detect the possible presence of H^3 in ordinary H_2 and in D_2O and in certain transmutations where it and He^3 are believed to be produced. N. M. B.

4255. Abundance Radio of Isotopes in Natural or Isotopically Separated Carbon. A. R. Brosi and W. D. Harkins. *Phys. Rev*. 52. *pp*. 472–474, *Sept*. 1, 1937.—The relative intensity of the 1·0 band heads of the $C_{12}C_{12}$ and $C_{12}C_{13}$ molecules in the Swan system of the C_2 spectrum has been measured by a photographic spectrophotometric method and found to be 0·0217 ± 0·0009. This yields a value of 92·2 ± 3·7 for the C_{12}/C_{13} abundance ratio of the C isotopes in good agreement with the value reported by Vaughan, Williams and Tate (91·6 ± 2·2), from mass-spectrographic data. This work was done in connection with the development of a simple method suited to the determination of the abundance ratio in the small samples obtained in the separation of natural C into isotopes. This method is described. AUTHORS.

4256. The Neutron. F. Cernuschi. *J. de Physique et le Radium*, 8. *pp*. 273–276, *July*, 1937.—If the neutron is assumed to be composed of a proton and an electron, it is found when Schrödinger's relativistic equation is applied that there is only a single stable state, which has a life of 10^{-27} sec. It is therefore suggested that the electron, the positron and the neutron should be taken as fundamental particles. The proton would then consist of a neutron and a positron. On this basis, the effective cross-section for photoelectric disintegration of a proton can be calculated. C. B. A.

4257. Electron Emission from Substances Traversed by Fast Neutrons. S. Kikuchi and H. Aoki. *Phys. Math. Soc., Japan, Proc*. 19. *pp*. 734–748, *Aug*., 1937. *In English*.—Experiments of the passage of neutrons through matter are studied by the counter method [see Abstract 973 (1937)]. The results can be interpreted only on the hypothesis that the electrons that are emitted are due to the interaction of the neutrons and the atoms of the substance. The present work shows that these electrons are not due to the secondary γ-rays excited in various parts of the apparatus. C. J. B. C.

4258. Scattering of Neutrons by Ortho- and Para-Hydrogen. J. Schwinger and E. Teller. *Phys. Rev.* 52. *pp.* 286–295, *Aug.* 15, 1937.—If neutrons are scattered by H_2 molecules, the scattering resulting from the two protons in each molecule shows interference and, therefore, the total scattering cross-section of the molecule depends on whether the two proton spins are parallel or antiparallel. It is shown that the ratio of the p- and o-H_2 scattering cross-sections depends very much on the temperatures of the neutron, on the range of the interaction forces, and on the question whether or not there is a stationary state of the deuteron with no resulting spin. Measurements of the scattering of thermal neutrons at room- and at liquid-air-temperatures by p- and o-H_2 would therefore provide important information about nuclear forces.

R. P.

4259. Scattering of Slow Neutrons. M. Goldhaber and G. H. Briggs. *Roy. Soc., Proc.* 162*A*. *pp.* 127–143, *Sept.* 1, 1937.—Improved methods for measuring the "total" and the scattering cross-sections of the elements for slow neutrons are described. Determinations of the total cross-sections for a few elements and of the scattering cross-sections for the majority of the elements have been made and are summarised in tables. In contrast with the cross-section for true absorption which varies by factors of the order of 10^6 for different elements the scattering cross-section varies only by factors of the order of 10. The scattering of slow neutrons in H_2 is studied from various points of view (influence of chemical binding, slowing down of neutrons of medium velocity, etc.) It is found that elements heavier than H_2 do not slow down neutrons of medium velocity appreciably. An upper limit for the cross-section for scattering of slow neutrons by electrons is found; it is about 10^{-27} cm^2.

AUTHOR.

4260. Inelastic Scattering of Fast Neutrons. G. T. Seaborg, G. E. Gibson and D. C. Grahame. *Phys. Rev.* 52. *pp.* 408–414, *Sept.* 1, 1937.—The radiation observed in the presence of a source of fast neutrons is found to be due chiefly to the excitation of γ-rays in the lead block used in these experiments. The true absorption of fast neutrons in several elements is less than previous measurements had indicated, and hence an absorption process cannot account for the soft γ-rays produced by the action of fast neutrons on matter. The capacity of fast neutrons to produce γ-rays in Pb and Cu is considerably diminished as a result of their passage through various substances. Therefore the energy of the γ-rays must be derived from the kinetic energy of the fast neutrons by a process of inelastic scattering. AUTHORS.

4261. Production and Properties of Low Temperature Neutrons. W. F. Libby and E. A. Long. *Phys. Rev.* 52. *pp.* 592–603, *Sept.* 15, 1937. —Evidence has been found that (a) hydrogenous substances so cold that nearly all the molecules are in the ground state can cool only those neutrons whose kinetic energies are great enough to excite the molecules to their first state, *e.g.*, the temperature of neutrons cooled by a crystal of such molecules at the absolute zero will approximate the temperature at which the specific heat begins to rise above the normal curve of the Debye type for crystalline specific heat; (b) the probability of energy loss to a liquid or crystal as a whole seems to be small; (c) for hydrocarbons, the limiting temperature for cooling neutrons appears to decrease with increase in length of the hydrocarbon chain. A neutron thermometer, using the absorption by B, has been tested and calibrated approximately. AUTHORS.

4262. Molecular Structures of Iron and Cobalt Nitrosocarbonyls. L. O. Brockway and J. S. Anderson. *Faraday Soc., Trans.* 33. *pp.* 1233–1239, *Sept.*, 1937.—The molecular structures of Fe $(NO)_2(CO)_2$ and Co(NO) $(CO)_3$ are investigated by the electron diffraction of the vapours. The bonds from metal to C and N respectively, are observed to be about 0·16 Å. less than the sum of the single bond covalent radii while the bond lengths in the CO and NO groups are intermediate between double and triple bonds. These observations are compared with earlier ones for $Ni(CO)_4$, and the resonating electronic structure proposed for the Ni compound is also proposed for the Fe and Co compounds. AUTHORS.

4263. Coefficient of Association and its Temperature Dependence. P. Guareschi. *Accad. Lincei, Atti,* 25. *pp.* 516–518, *May* 8, 1937.—A semi-empirical formula is derived according to which the coefficient of association in liquids is connected with the surface tension and the thermal expansion. In particular the temperature variation of the association should be given only by the coefficient of thermal expansion. This formula represents the experimental results fairly well. R. P.

4264. Calculation of the Energy of H_3 and of H_3^+. Part III. J. Hirschfelder, H. Diamond and H. Eyring. *J. Chem. Phys.* 5. *pp.* 695–703, *Sept.*, 1937.—In previous communications [see Abstract 941 1936)] the energy of H_3 and H_3^+ was calculated by the variational method for the symmetrical linear configurations. In this paper, these energies are obtained for two unsymmetrical linear configurations using the most general eigenfunction which can be formed out of 1*s* H-like atomic orbitals. Two of the four difficult exchange integrals which involve the coordinates of three nuclei are obtained in closed form. For the Wang plus polar states approximation, the activated state for the reaction $H + H_2$ is found to be linear symmetrical whereas the semi-empirical calculations give an unsymmetrical activated state. The complete potential energy surface for three H atoms on a line is constructed, for this Wang plus polar states approximation. The energy of the triatomic positive ion is likewise lowest for the linear symmetrical. The complete energy surface of $H_2 + H^+$ in a line is constructed and the vibration frequencies are computed. The frequency of the linear symmetrical vibration for H_3^+ is $1 \cdot 4 \times 10^{14}$ wave no. per sec. and the frequency of the linear unsymmetrical vibration is $1 \cdot 2 \times 10^{14}$. AUTHORS.

See also Abstracts **4230, 4314, 4319, 4328, 4363, 4401, 4449, 4451, 4455, 4508, 4529, 4532, 4543, 4556, 4557, 4558, 4559, 4562, 4699, 4709.**

COLLOIDS.

4265. Coacervation. Parts I and II. H. G. B. de Jong. *Kolloid Zeits.* 79. *pp.* 223–232, *May*; 80. *pp.* 221–231, *Aug., and pp.* 350–360, *Sept.*, 1937.—These two papers assemble the work of the author and his collaborators with respect to the mechanism of the disintegration phenomena which occur in hydrophilic biocolloidal sols. Since disintegration and flocculation of these sols are related phenomena, the results of this investigation are also of importance for the interpretation of flocculation processes. [See Abstracts 26 and 943 (1936)]. H. H. Ho.

4266. Electroviscous Effect and Discharge of Sodium Arabinate Sols. L. W. J. Holleman and H. G. B. de Jong. *Kolloid-Beihefte*, 46. 1–4. *pp*. 113–133, 1937.—The viscosity and electrophoresis of 1·6% aqueous sols of sodium arabinate with additions of LiCl, $MgCl_2$, $CaCl_2$, $BaCl_2$, $Cu(NO_3)_2$, $Cd(NO_3)_2$, $Ce(NO_3)_3$, $Pb(NO_3)_2$ and $UO_2(NO_3)_2$ have been studied as functions of electrolyte concentration *c*. In all cases, both properties exhibit minima at particular values of *c*, but these values of *c* are not identical, a minimum viscosity being reached at a lower value of *c* than that producing discharge (*i.e.* no electrophoresis). The discrepancy is attributed to "inaccessibility" of the dispersoid to electrolyte in the case of the electrophoresis measurements, for which it was adsorbed to silica. Both properties exhibit the identical series $Ce^{\cdot\cdot\cdot} < (UO_2)^{\cdot\cdot} < Pb^{\cdot\cdot} < Cu^{\cdot\cdot} < Cd^{\cdot\cdot} < Ba^{\cdot\cdot} < Ca^{\cdot\cdot} \cong Mg^{\cdot\cdot} < Li^{\cdot}$ (critical concentration values). The results are considered in the light of the Einstein-Smoluchowski equation; they are not quantitatively in agreement with it, but suggestions are made, based upon the mechanism of attraction between colloid and electrolyte ions, indicating the connexion between viscosity and electrolyte concentration. L. V. C.

4267. Influence of Electrolytes on Non-Aqueous Solutions of Nitrocellulose. A. Kargin and N. V. Michailoff. *Acta Physicochimica*, 6. 6. *pp*. 823–858, 1937. *In German*.—Conductivity, viscosity and ζ-potential determinations of acetone solutions of nitrocellulose (NC) show that the conductivity is not due to dissociation of the NC but to the presence of electrolyte, that the viscosity shows a maximum change at the neutralisation point, that purified NC has no charge and only a very small one when HNO_3 or NH_3 is present, though adsorption of these by NC in such solutions is relatively great and purely molecular, that there is no connexion between the ζ-potential and the viscosity, the variation in which latter is due to molecules of electrolyte in the solvate shell. The changes in ζ-potential due to heavy metal salts resemble generally those caused by HNO_3 or NH_3; such electrolyte molecules of great dipole moment appear in the solvate shell and destroy the connection between the NC particles. NPr_4I in a solution of dialysed NC shows predominant kathode particle transport. [See Abstract 2321 (1937).] C. A. S.

4268. Electrochemistry of Platinum Sols. Part II. Nathalie Bach and A. Rakov. *Acta Physicochimica*, 7. 1. *pp*. 85–94, 1937. *In English*.—Pt sols of various concentrations, prepared by arcing Pt in an atmosphere of H_2, O_2 or air at different temperatures, were coagulated by means of freezing and remelting. In the case of H_2-Pt-sols, the liquid obtained by melting the frozen sol is identical with the intermicellar liquid. The difference between its conductivity and that of the sol corresponds to the colloid's own conductivity; this difference increased with the concentration of the sol and reached 75% of the total conductivity when the concentration was 360 mg./l. Pt sols prepared in an atmosphere of H_2 consist of Pt particles and H-ions, forming the diffuse part of the double layer. In the case of O_2-Pt-sols the difference between the conductivity of the coagulated and original sols is constant at all concentrations; it cannot be interpreted as the colloid's own conductivity, because of the presence of electrolytes. Air-Pt-sols are similar to O_2-Pt-sols, but their structure is still more complicated. [For Part I see Abstract 4787 (1935).] AUTHORS.

4269. Electrokinetic Potentials at Metal Surfaces. J. F. Chittum and H. Hunt. *Am. Electrochem. Soc., Trans*. 71. *pp*. 207–217; *Disc*., 217–223, 1937.—The electrokinetic potentials of several metals are measured in various electrolytes and colloidal solutions. The theories of Procopiu and Koenig are experimentally tested and discussed. The data show that the properties of a metallic electrode, especially its electrokinetic potential, are governed by the colloidal metal in the electrode surface. The results indicate the necessity for a modified form of the Helmholtz double layer as was presented in a previous paper [see Abstract 1802 (1937)]. AUTHOR.

4270. Electrophoresis of Lamellæ at the Interface of Liquid Phases. L. I. Belajev. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* **15.** **5.** *pp.* **249–253,** 1937. *In English.*—The electrophoretic movements of colloidal Au lamellæ at the interface between an aqueous Au sol and isoamyl alcohol were studied. The observed velocities (both towards anode and towards kathode) were considerably greater than normal electrophoretic velocities. This fact together with the bilateral character of the movements suggests that the latter are not due to a true electrophoresis of the sol, but to adsorption occurring on the sol particles. Movement does not occur when air replaces the upper isoamyl alcohol layer. L. V. C.

4271. Potential and Transport Measurements in Ferric Hydroxide Sols. A. Lottermoser and H. Fritzsche. *Kolloid Zeits.* 80. *pp.* 166–174, *Aug.*, 1937.—A method of determining the included Cl by aid of transport measurements is described. The method was limited to a range of concentrations, the lower limits being $2 \cdot 44 \times 10^{-2}$ mol. FeO/l., and $4 \cdot 70 \times 10^{-3}$ mol. Cl/l. The effect of the voltage used for the transport measurements was investigated and it was found that it had no influence between from 72 to 1000 V. The measurements were carried out with ripened sols, since it was found that fresh sols underwent changes during the measurements. The results obtained were compared with the activities determined by measurements with calomel and AgCl electrodes. Satisfactory agreement was obtained. F. J. B.

4272. Rigidity and Constitution of a Thermoreversible Gel. F. Hirata. *Imp. Acad. Tokyo, Proc.* 13. *pp.* 266–269, *July*, 1937. *In English.*—The rigidity of a typically thermoreversible aqueous gelatin gel at the isoelectric point was determined at various temperatures between 5·8 and 22·6° C. The variation of rigidity with temperature is directly related to the change in dielectric constant of the intermicellar liquid, assumed to be pure water, with temperature. This is in agreement with the micelle theory of gels, the electrostatic forces between the micelles being dipolar in nature. A. J. M.

4273. Liesegang Rings. T. Okaya. *Japanese Journ. Phys.* 12. *pp.* 9–25, *March*, 1937. *In French.*—The velocity parallel to the axis at various points of a cylinder of viscous liquid when the external surface is caused to move with uniform velocity, assuming no friction between the liquid and the containing cylindrical wall, is discussed mathematically; and an analogy between the velocity so calculated and the concentration of Ag. ions in a drop of $AgNO_3$.aq. on gelatin impregnated with $K_2Cr_2O_7$, as it spreads over the gelatin is pointed out. [See Abstract 1439 (1937).] C. A. S.

4274. Influence of Light on the Rhythmic Precipitation of Silver Chromate in Gelatin. M. Köhn and L. Mainzhausen. *Kolloid Zeits.* 79. *pp.* 316–318, *June,* 1937.—The effect of light on the rhythmic precipitation of $AgCrO_4$ in gelatin depends on the Cl (halogen) content. In the absence of Cl (halogen) no effect of light is noticeable.

Increase of Cl content delays the rhythmic precipitation in the dark and tends to make $AgCrO_4$ under illumination form Liesegang rings having a secondary structure. J. K.

4275. Rhythmic Precipitation in Electric Field. T. Okaya. *Phys. Math. Soc. Japan, Proc.* 19. *pp.* 657–676, *July,* 1937. *In French.*—Liesegang layers were formed in a vertical capillary tube filled with gelatin impregnated with $K_2Cr_2O_7$, the lower end of which dips in a solution of $AgNO_3$. The height at which, and time after first insertion when, each layer was formed were determined. If l_n and t_n are corresponding heights and times for the *n*th layer $l_n/t_n^{\frac{1}{2}}$ $(=\beta_n)$ is approximately constant if *n* be small. On passing an electric current through the tube and solution the rhythmic precipitation continues but the position and time intervals of the layers change, β_1 becomes $\overline{\beta}-kv$, where $\overline{\beta}$ and k are constants. $\overline{\beta}$ also increases parabolically with temperature. The current in the tube diminishes exponentially with time. C. A. S.

4276. Structure of Rubber "Single Crystals". E. Sauter. *Zeits. f. phys. Chem.* 36. *Abt. B.* 5–6. *pp.* 405–426, 1937.—By means of the X-ray technique used in the investigation of cellulose [see Abstract 1440 (1937)] the author derives a structure for "single crystals" of rubber which are obtained by stretching specimens 700%. The "unit cell" is orthorhombic with the following parameters, $a = 12 \cdot 60 \pm 0 \cdot 05$, $b = 8 \cdot 20 \pm 0 \cdot 05$, $c = 8 \cdot 91 \pm 0 \cdot 05$ Å. There are 8 isoprene residues in the cell giving a calculated density of 0·974 compared with the experimentally found value of 0·965. The author discusses the arrangement of the molecular chains in the cell and the micro-structure of the rubber. J. I.

4277. Structure of Cellulose. E. Sauter. *Zeits. f. phys. Chem.* 36. *Abt.B.* 5–6. *pp.* 427–434, 1937.—In the present paper the author replies in detail to the criticisms of Mark and Mayer [see Abstract 3828 (1937)] and reaffirms his original results. J. I.

4278. Available Surface of Cellulose. O. R. Howell and A. Jackson. *Chem. Soc., J. pp.* 979–982, *June,* 1937.—An estimate of the available surface of a pure cotton-cellulose filter-paper used in $CoCl_2$ absorption spectra studies [see Abstract 4530 (1937)] was made from the apparent saturation values of light absorption as the concentration of a treating solution of $CoCl_2$ was increased. The available surface is 85 times as great as the apparent surface (including canals) deduced microscopically, assuming the salt to lie in unimolecular layers. This observation agrees with one made by Stamm for wood cellulose and is in line with recent theories according to which the cotton fibre is composed of discrete chains of cellulose particles of uniform size, separated from one another by surface layers of pectin. L. V. C.

4279. Mechanics of "Spinning." R. K. Schofield and G. W. S. Blair. *Kolloid Zeits.* 79. *p.* 308, *June,* 1937.—The characteristics of a liquid capable of being spun, *i.e.*, drawn into threads or filaments are considered with particular reference to certain South African honey-like substances which are shown to have an elastic lattice structure and an abnormal meniscus when flowing through a tube. J. K.

4280. Spinnability of Liquids. H. Erbring. *Kolloid Zeits.* 80. *pp.* 20–27, *July,* 1937.—Sols containing 40 gm. gel/100 cc. Ca-salt solution showed a viscosity minimum at a common Ca normality of 1·4, whether $Ca(SCN)_2$, $CaCl_2$ or $Ca(NO_3)_2$ were employed. The absolute viscosity values depended upon the anion and gave, for "liquefying action," the lyotropic series SCN$>NO_3>$Cl. At Ca concentrations on either side of the minimum there was pronounced thixotropy, but it was not possible (as in more dilute gelatin sols) to distinguish between a mechanically labile and a mechanically stable component [see Abstract 2328 (1937)]. At such Ca concentrations (*i.e.*, approaching coagulation) there was also increasing spinnability; the latter was a minimum at the same figure of 1·4 M, in conformity with earlier findings [see Abstract 5350 (1936)]. The spun threads of the more thixotropic sols showed double refraction. The behaviour is explained by two opposed actions of Ca on gelatin, one leading to increasing dispersity and the other to coagulation. [See also Abstract 29 (1937).] L. V. C.

4281. Impregnation with Colloidal Graphite. B. H. Porter. *J. of Applied Physics*, 8. *pp.* 479–482, *July*, 1937.—Impregnation is considered with reference to the degree of wetting of a solid by a liquid, the magnitude of the solution's surface tension, the surface properties of the material to be impregnated, and the Fichtner-Sahlbom effect from surface charges. Reference is then made to the treatment of commercial products, line cloth, paper, asbestos, leather, cork, and porous materials. J. K.

4282. Disperse Gases. Part II. R. Auerbach. *Kolloid Zeits.* 80. *pp.* 27–31, *July*, 1937.—This paper supplements the previous theoretical treatment [see Abstract 1933 (1936)] by a systematic survey of the technical features (as for example in the washing of gases by liquids). The subject is studied under headings (i) general properties of disperse gases (stability as influenced by solubility or stabilisers, relation between gas-particle size and volume through-put, dispersoid analysis, optical and electrical properties), (ii) preparation of disperse gases by condensation methods (pressure release, lowering of solubility, chemical, electrochemical and biological methods), (iii) preparation by dispersion methods (nozzles and filter-candles, injectors, rotors, etc.). L. V. C.

4283. Disperse Gases and Their Importance in Nature and Technology. A. Krause and K. Kapitańczyk. *Kolloid Zeits.* 80. *pp.* 273–286, *Sept.*, 1937.—This paper deals with gas-liquid sols which have been prepared by a condensation process already described [see Abstract 2809 (1935)] in strong alkaline medium; the following gases are dealt with: air, O_2, N_2, H_2, CO, CH_4, C_2H_4, and C_2H_2. Gas bubbles of $2 \cdot 9 - 4 \cdot 6$ $\mu\mu$ dia. were the smallest found for colloidal O_2, N_2, CH_4 and air. The great difference in refractive index between the strongly alkaline medium and the colloidally dispersed gas favoured the accuracy of the magnitude determinations. The ultramicroscopic bubbles exhibited the Brownian movement, and their colour varied from green (for the smallest drops) to yellow, then pink to white (for the largest drops). The colloidal gases were mostly mono-dispersed, although poly-dispersed ones occurred especially in aged sols. In general these gases gave rise to foams on keeping, which were to be regarded as coagulated systems; colloidal H_2 and CO, however, exhibited little or no tendency to foam formation. Foams, which for the greater part arose from ultramicroscopic drops, could be prepared from concentrated NaOH and a few drops of 30% H_2O_2, and had the appearance of semi-solid material which was easily dispersed in the medium, *e.g.*, O_2. Under suitable experimental conditions, the NaOH + H_2O_2 systems afforded blue-green colours, which may also

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be developed by impurities present such as compounds of Mn, Pb, and Fe. H. H. Ho.

See also Abstracts 4295, 4306, 4484, 4596, 4597.

CRYSTAL STRUCTURE AND PROPERTIES.

4284. Structure of Aluminium Wire Subjected to Alternating Torsion. R. Jacquesson. *Comptes Rendus*, 205. *pp.* 331–332, *Aug.* 2, 1937.—When Al wire which has been maintained for several hours at 550–600°, is subjected to alternate twists, the crystals therein, which may be up to 8 mm. long, behave as tiny cylinders, and when examined by X-rays indicate an increasing (with the twisting) disintegration into crystallites of which the direction may finally vary up to more than 10° from that of the original crystal. The predominant direction of the crystallites is that of the 110 axis that is least inclined to that of the wire. The original crystal is thus transformed into a fibrous aggregate. C. A. S.

4285. X-Ray Interference at Distorted Lattices. W. Boas. *Zeits. f. Krist.* 97. 5. *pp.* 354–369, 1937.—This paper continues previous work [see Abstract 1447 (1937)] on the disturbance which a crystal suffers through plastic deformation and which is irregularly distributed in the lattice. The change of X-ray intensities is explained by periodic disturbances of a part of the lattice, although the form of the disturbance plays no essential rôle. The potential energy of the lattice is raised by the uniform displacement of a part of the atom from its resting-position much less than by a statistical irregular displacement of all the atoms. The great discrepancy between the measured and the calculated increase (on the assumption of the irregular displacement of all the atoms) of the internal energy is therefore considerably smaller. The widening of the interference lines due to the plastic deformation appears not to be explained by periodic disturbances of the lattice, but to the essential part played by elastic forces which are homogeneous throughout the great part of the lattice ($\sim 0\cdot5\mu$). H. H. Ho.

4286. Energy of Lattice Distortion in Cold-Worked Permalloy. F. E. Haworth. *Phys. Rev.* 52. *pp.* 613–620, *Sept.* 15, 1937.—The lattice distortion produced by severe cold working of permalloy of 70% Ni content has been studied by measuring the broadening of the reflection of the Fe Kα doublet by the (311) planes, with a focusing camera. The broadening decreases upon annealing and recovery is complete at 650° C., when the breadth of the X-ray intensity curve at half-maximum is as small as that obtained by use of the two-crystal spectrometer. The mean square distortion in the lattice spacing due to cold work is derived from the X-ray measurements after photometering the X-ray film, converting the curve into an X-ray intensity curve, fitting the latter with an empirical equation and using an analysis worked out by S. O. Rice. The energy of the distortion is then calculated by using an equation derived by G. R. Stibitz. The r.m.s. distortion was found to be 0·31% of the lattice spacing after the material had been reduced 96% in cross-sectional area by cold working. The energy of distortion in the hard-worked condition is thus found to be 23 ± 10^6 ergs/cm^3. or 0·065 cal./gm. AUTHOR.

***4287. Effect of Heat upon the Structure of Gold Leaf. G. L. Clark and E. Wolthuis.** *J. of Applied Physics*, 8. *pp.* 630–638, *Sept.*, 1937.—The construction of an electron diffraction apparatus is described, adapted to both reflections and transmission studies of crystalline materials and built in the laboratory at a moderate cost. This apparatus involves several novel features of construction and utilises an electrode magnet for obtaining a homogeneous beam of electrons. The application of the instrument to chemical problems is illustrated by the results of a study of the effect of heat and of various gaseous atmospheres upon the structure of gold leaf. Microscopic, X-ray and electron diffraction evidence indicate that at a temperature of about 400° the gold in a leaf flows into aggregates or larger crystal grains. This coagulation explains the contraction of the leaf as observed visually, the opacity of many patches in the heated leaf as observed microscopically, and the appearance of spots in the diffraction patterns. A "many ring" pattern observed when the leaf is heated in air or O_2 is attributed to the formation of an oxide which is rather unstable at about 400°. This observation clarifies some discrepant data in the literature. AUTHORS.

4288. Transition from Hexagonal to Cubic Electrodeposited Chromium. W. A. Wood. *Phil. Mag.* 24. *pp.* 511–518, *Sept.*, 1937.—A determination is made of the exact temperature range over which electroplated Cr with hexagonal atomic structure undergoes transformation to the cubic form. It is found that the X-ray diffraction rings exhibit a distinct increase in breadth when comparison between the spectra of the cubic product and the initial hexagonal material is made. The decrease in the crystallite size causing this effect is measured, as well as the characteristic crystallite size of the hexagonal Cr and directly deposited cubic Cr. It is shown that the cubic Cr produced by the transformation will be harder than the hexagonal type and resemble the normal cubic deposit, and that therefore the softening effect of any hexagonal constituent in a deposit may be effectively removed. AUTHOR.

4289. Structures of Meteoric Irons. G. Derge and A. R. Kommel. *Am. J. Sci.* 34. *pp.* 203–214, *Sept.*, 1937.—The perfection of crystalline structures in Cañon Diablo and Amalia Farms meteorities was determined by X-rays and by measurement of the trace directions of the kamacite plates. The metallographic features of the Cañon Diablo sample were observed. A Widmanstätten pattern, comparable with those found in meteorites, was developed in an alloy of iron with 27% Ni. These findings are discussed in relation to currently accepted metallurgical knowledge and the conclusion is drawn that the structures found in metallic meteorites were formed during slow cooling from high temperatures. AUTHORS.

4290. Effect of Pressure and Temperature on the Occlusion of Hydrogen by Palladium. E. A. Owen and J. I. Jones. *Phys. Soc., Proc.* 49. *pp.* 587–602, *Sept.* 1, 1937.—The lattice parameter of Pd has been measured at various temperatures from 80° C. to 160° C. when the Pd was surrounded by H_2 at pressures varying from 0 to 760 mm. Hg. Two phases occur in the system $Pd-H_2$ and at constant temperature the relation between parameter of Pd and pressure of H_2 is found to be linear for both phases. For low concentrations of H_2 the lattice parameter of Pd varies directly as the pressure of H_2 and inversely as the square of the temperature. Entrance of H_2 atoms into the Pd lattice appears to loosen the bonds between the Pd atoms allowing them to separate more easily on heating. The parameter of Pd free from gas is $3{\cdot}8825_6 \pm 0{\cdot}0003$ Å at 20° C. and the mean coefficient of thermal expansion between 0 and 300° C. is $12{\cdot}7 \times 10^{-6}$ per °C. [See following Abstract.] J. I. J.

4291. Palladium-Hydrogen System. E. A. Owen and J. I. Jones. *Phys. Soc., Proc.* 49. *pp.* 603–610, *Sept.* 1, 1937.—The hysteresis effect observed in the Pd–H_2 system when the pressure of H_2 is taken through a cycle of changes is investigated by the X-ray method. It is found that where the pressure of H_2 is varied those parts of the ascending or descending isothermals in which a single component exists are reversible but when the two phases are present the corresponding portion of the isothermals is irreversible. [See preceding Abstract.] J. I.

4292. Structure of Compounds of Rare Earths. A. Iandelli and E. Botti. *Accad. Lincei, Atti,* 25. *pp.* 498–502, *May* 8, 1937.—A continuation of previous work [see Abstracts 1450 and 2349 (1937)]. In this paper an account is given of investigations on compounds of the type MeAs and MeSb (Me = La, Ce, Pr). The three arsenides were examined by the powder method using K radiation and anti-kathodes of Cu and Fe. With Cu the continuous background was so intense that reading was difficult. With an antikathode of Fe the photograms were notably clear. The results are recorded in a set of tables. J. J. S.

4293. Density and Structure of Zircon. Part II. M. v. Stackelberg and K. Chudoba. *Zeits. f. Krist.* 97. 4. *pp.* 252–262, 1937.—Previous investigations [see Abstract 5365 (1936)] on the density of zircon have been continued by X-ray studies of two specimens of very light zircon of density 3·9: the normal density of zircon is 4·15. One of these samples was found to consist of amorphous SiO_2 and microcrystalline cubic ZrO_2, whilst the other one was entirely amorphous, though heating this one to 900° C., turned the ZrO_2 into a crystalline state. These facts taken in conjunction with the knowledge that the quick cooling of molten zircon produces a mixture of an SiO_2-glass and crystalline zircon are considered to give a satisfactory explanation of the light naturally occurring zircons. Intermediate examples between normal and completely decomposed zircon were investigated, but no regularities between density, X-ray structure and optical properties could be traced. G. G.

4294. Structure of Alkali Per-Rhenates and Per-Iodates. J. Beintema. *Zeits f. Krist.* 97. 4. *pp.* 300–322, 1937.—The structures of the per-rhenates of Na, NH_4, Rb, Tl and Cs, and of the per-iodates of NH_4, Rb and Cs, are determined. $NaReO_4$, NH_4ReO_4, $RbReO_4$, NH_4IO_4 and $RbIO_4$ have the scheelite structure but $CsReO_4$ and $CsIO_4$ have a different structure which may be derived from the scheelite structure by a slight deformation. The symmetry is thereby reduced from tetragonal to orthorhombic and the new structure is referred to as the pseudo-scheelite type. Below 123°C. $TlReO_4$ has the pseudo-scheelite structure but above this temperature the structure changes to the scheelite type. The space-group of the pseudo-scheelite structure is D_{2h}^{16}—P*nma* and the atomic positions are determined in each case. The lattice dimensions of the various salts examined are given. J. T.

4295. Fibrous Structure of Paraffin. H. Riusan. *Kyoto Coll. Sci., Mem.* 19. *pp.* 279–282, *Nov.*, 1936. *In English.*—A study of the fibrous structure of paraffin which has been drawn into the shape of a wire, and of its relation to temperature. AUTHOR.

4296. X-Ray Study of Diacylperoxides. M. Milone. *Accad. Sci. Torino, Atti,* 72. *Disp.* 3a. *pp.* 425–430, *April-Oct.*, 1937.—The crystal structure and molecular symmetry of dibenzoyl peroxide $(C_6H_5.COO)_2$, and di-*p*-tolylperoxide $(CH_3.C_6H_4.COO)_2$, are determined. The former exhibits rhombic symmetry—space group D_2^3—and unit cell $a = 5{\cdot}34$, $b = 8{\cdot}46$,

$c = 11 \cdot 04$Å, and the latter is monoclinic, space group, C_s^3 and unit cell $a = 14 \cdot 62$, $b = 10 \cdot 13$, $c = 8 \cdot 51$, $\beta = 113°31$. There are 2 and 4 molecules in the unit cell respectively. C. J. B. C.

4297. Structure of Tri-thio-Formaldehyde. N. F. Moerman and E. H. Wiebenga. *Zeits. f. Krist.* 97. 4. *pp.* 323–331, 1937.—This compound forms orthorhombic crystals with the following unit cell dimensions, $a = 7 \cdot 63 \pm 0 \cdot 03$, $b = 7 \cdot 00 \pm 0 \cdot 03$, $c = 5 \cdot 25 \pm 0 \cdot 03$ Å; space-group $= C_{2v} - Pmn$; 2 mol. per unit cell; density $= 1 \cdot 59$. A molecular arrangement is proposed on the basis of estimated intensities of reflections. The six-membered ring has the " chair " form (Siessel form), the distance C-S in the ring being $1 \cdot 81 \pm 0 \cdot 06$ Å which agrees with the value calculated by Pauling. The valence angle of all the atoms is, within the limits of measurement 109°28′. The intermolecular distances S-S, CH_2-S and CH_2-CH_2 are all equal to $3 \cdot 6$ Å. J. I.

4298. Orientation of Rows of Molecules in Layers of Organic Acids. V. V. Čelincev. *Comptes Rendus* (*Doklady*) *de l'Acad. de Sciences, U.S.S.R.* 16. 2. *pp.* 95–97, 1937. *In English.*—Long-chain organic acids when forming layers have their molecular chains inclined to the plane of the layer at about 50°. This is in contrast to compounds such as paraffins which have their molecular chains normal to the plane on which they lie. The author suggests that this difference is due to the formation of complexes between pairs of acid molecules (oxonium forms). J. I.

4299. Anisotropic Liquids. W. Kast. *Phys. Zeits.* 38. *pp.* 627–635, *Aug.* 15, 1937.—In this theoretical paper the author deals with the more complex organic compounds of the type called " liquid crystals " by Lehmann; the author, however, prefers the term " anisotropic liquids " in contradistinction to M. and G. Friedel's " intermediate phases." The molecular structure and mode of vibration of the atom groups are discussed in detail for the anisotropic state of the substance and the mechanism of transition into the isotropic form suggested. R. L.

4300. Rearrangement of Metal Crystals by Recrystallisation. U. Yoshido and S. Nagata. *Kyoto Coll. Sci., Mem.* 19. *pp.* 207–213, *Sept.*, 1936. *In English.*—Pieces of Al plate were annealed for 48 hr. at 320°, stretched 1-5%, and then, for varying periods, 0-22 min., heated at 630°; also single crystal sheets of Al were stretched 0·9-0% and then heated at 610° for varying periods up to 20 hr. All were examined by X-rays at suitable intervals. Several of the Laue photographs are reproduced. The results show that the orientation of the resultant crystals remained that of the original plate or sheet unless the elongation exceeded 2-3%. C. A. S.

4301. Crystallisation of Supercooled Sulphur in a Magnetic Field. W. W. Kondoguri. *Phys. Zeits. d. Sowjetunion*, 11. 6. *pp.* 571–575, 1937. *In German.*—Small drops of very pure molten S are kept between glass plates at various temperatures between 15 and 65° C. and the number of nuclei of crystallisation that have formed in a given time are then measured. It is found that in the presence of a magnetic field parallel to the plates the number is increased. A magnetic field at right angles to the plates decreases the number of nuclei. At the same time the parallel field displaces the maximum and minimum towards lower temperatures, while the transverse field has the opposite effect. The effect is more marked for thin layers. [See also Abstract 3972 (1936).] R. P.

4302. " Transformation " Temperature of a Metallic Film. T. Fukuroi. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 722. *pp.* 196–219, *Aug.*, 1937. *In English.*—The nature of the so-called " transformation " phenomena in the metallic films, *i.e.*, the abrupt irreversible decrease of resistance in the heating-up stage, has been investigated by studying the changes in electric resistance, reflectivity of light and X-ray diffraction with the temperature rise. The metals used were Cd, Zn, Hg, Mg, Sb, Pb, and Bi condensed on glass films. When the films were not too thin, the temperature at which the resistance decreases abruptly is not constant for any one of the metals, but a linear relation exists between the logarithm of the temperature and the thickness of the deposits. The lines showing such a linear relationship are always the same in their inclinations, and extrapolating them to the limit corresponding to zero thickness, the values are found which correspond to the recrystallisation temperatures of the massive metals. The author considers that the term " transformation temperature " should be replaced by " recrystallisation temperature." H. H. Ho.

4303. Regular Growth of Alkali Halides on Sodium Nitrate. W. Heintze. *Zeit. f. Krist.* 97. 4. *pp.* 241–251, 1937. *In German.*—The regular growth of alkali halides—NaI, NaBr, KBr in particular—on the rhombohedral faces of sodium nitrate crystals is described. It is found that the growth occurs in such a way that the cube edge of the halide is arranged parallel to one or other of the rhombohedron edges of the nitrate crystal. The predominating feature, determining growth, seems to be the effect of alternate + − + − . . . . . ionic chains rather than a close fit in the meshes of the atomic planes of the two crystals, though this indeed seems to have its effect in various secondary phenomena. The experimental results were found to be much influenced by conditions of concentration, temperature and type of solvent. G. G.

4304. Regular Association of $KMnO_4$ and $KClO_3$. H. E. Buckley. *Zeits f. Krist.* 97. 5. *pp.* 370–385, 1937. *In English.*—Parallel growths of $KMnO_4$ (Mn) and $KClO_3$ (Cl) are readily obtained from mixed saturated solutions of the two salts. The relative positions of the crystals are examined in great detail with the aid of many diagrams and photographs. The rule of association is [010] Mn‖ [100] Cl, and (100) Mn‖ (100) Cl which necessitates geometrically [001] Mn‖ [001] Cl ; while (001) Mn is always inclined to (001) Cl at an angle of 19½°. C. A. S.

4305. Course of Polymorphic Changes in Ammonium Nitrate. R. Tiemeyer. *Zeits. f. Krist.* 97. 5. *pp.* 386–400, 1937.—The transitions between the various polymorphic forms of NH_4NO_3 were followed by means of X-rays. These and the relations between them are illustrated by many diagrams, showing the dependence thereof on the rapidity with which the conditions, in particular the temperature change, and that each change is accompanied by polycrystalline disintegration. The metastable changes, *e.g.* II $\rightleftharpoons$ IV, are accompanied by considerable internal strain in the lattice. C. A. S.

4306. Formation of Atomic and Colloidal Centres of Silver in Alkali-Halide Phosphors. A. Toporec. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 15. 5. *pp.* 245–248, 1937. *In English.*—It has been shown in a previous paper that if electrons penetrate into a crystal of an alkali halide containing ionic Ag, atomic centres of Ag—A centres—as well as atomic centres of alkali metal—F centres [see Abstract 1440 (1936)] are formed. The number of either kind has been evaluated from absorption measurements. The number of Ag centres does not depend on the temperature while the number of alkali centres depends on temperature exponentially. This is taken to show that the electrons are mainly trapped by the Ag ions. In K salts above a certain limiting concentration of Ag, colloidal Ag is formed as well as atomic centres. In Na salts the Ag aggregates to colloidal centres at infinitesimal concentrations. J. E.

4307. Colouring of Zircon by Irradiation. J. Lietz. *Zeits. f. Krist.* 97. 5. *pp.* 337–353, 1937.—Absorption spectra of coloured zircons are observed during their decolorisation by u.v. irradiation. The Bunsen-Roscoe law is obeyed and the effect increases with decreasing wave-length. The curves appear to indicate three overlapping bands, of which that of longest wave-length is attributed to F′-centres, and the principal band to F-centres. C. B. A.

4308. Allotropic Change from α- to γ-Iron. A. Brüchanow. *Techn. Phys., U.S.S.R.* 4. 5. *pp.* 414–424, 1937. *In German.*—The elastic anisotropy of Fe sheet is observed during the allotropic change α-γ-α. Below the Ac_3 point no alteration in the recrystallisation texture is noted but the α-γ-α transition is accompanied by an alteration of elastic anisotropy in accordance with crystallographical laws. J. T.

4309. Elastic Limit of Aluminium Rod. M. Sugihara. *Kyoto Coll. Sci., Mem.* 20. *pp.* 27–33, *Jan.*, 1937. *In English.*—When cold-worked commercial Al rods are treated by heat for a constant time at several temperatures below the melting point, the crystal grains grow larger with the increase of the temperature. The growth of the grains is not remarkable below about 200° C.; but after exceeding that temperature, the growth becomes considerable. The limit of elasticity decreases slowly at a lower temperature, then rapidly and again slowly with the increase of annealing temperature. The relation between the limit of elasticity and the grain number per unit length is expressed very simply by an empirical formula. AUTHOR.

4310. Mechanical Effect of Crystal Boundary. B. Chalmers. *Roy. Soc., Proc.* 162*A*. *pp.* 120–127, *Sept.* 1, 1937.—The effect of the boundary between the crystallites in a metal specimen on the mechanical behaviour is of fundamental importance for the understanding of the strength of polycrystalline metals. The investigation deals with a particularly simple case, in which the effect of a single boundary can be measured. The specimens tested consist of two crystals with a longitudinal boundary prepared so that the orientation of the lattices of the two crystals with respect to the direction of the stress is the same in all cases, while the angle between the two lattices varies from specimen to specimen. The results show that the critical tension varies regularly with the angle between the two crystals, being a minimum when the two lattices are similarly orientated (*i.e.* for single crystals) and a maximum when the two lattices are at right angles. It is concluded that the boundary has no inherent strength, and that the results are best explained as the effect of a transitional lattice. The evidence is against the existence of an " amorphous layer " or " intercrystalline cement." AUTHOR.

4311. Reflection of X-Rays in Polycrystalline Substances. A. Reis. *Comptes Rendus,* 205. *pp.* 369–371, *Aug.* 9, 1937.—A beam of X-rays, after reflection from a perfect crystal and passing through a collimator falls on the crystal under examination (A) centred on the axis of a spectrometer. The reflected spots are photographed before and after a slight change (through an angle ω) in orientation of A. If ω considerably exceeds δ, the angular domain of reflection, the two sets of spots are distinct, if less they are more or less coincident. The ratio of the number of spots (N) resulting from a pair of exposures with the orientation of the crystal separated by the angle ω to that of the number (N_0) after one exposure is plotted against $\omega\cos\phi$, where ϕ is the azimuth of the point at which the imperfection is measured, and this ratio shows the degree of imperfection. A modification of the above method not requiring either a perfect crystal or accurate spectrometer is also described. C. A. S.

4312. Absorption Factor for the Rotating Crystal Method of Analysis. O. P. Hendershot. *Rev. Sci. Instruments,* 8. *pp.* 324–326, *Sept.,* 1937.—An extensive survey of this problem has been made by Bradley [see Abstract 3753 (1935)], and a solution given for cylindrical powder specimens and for zero layer reflections for a crystal which has been ground into a cylinder and is rotated about the cylinder axis. Till now no solution has been given for crystals which have to be used in the form in which they crystallise. A method is developed for highly absorbing crystals, and equations derived which are valid only for zero layer reflections on rotation or oscillation photographs or the corresponding spectrometer data. The solution is partly graphical. C. J. B. C.

***4313. X-Ray Photogoniometer. M. Milone.** *Accad. Sci. Torino, Atti,* 72. *Disp.* 3*a. pp.* 378–385, *April–Oct.,* 1937.—A new simplified X-ray photogoniometer is described and constructional details are given. With the one apparatus Laue, Debye-Scherrer, and Weissenberg photographs may be obtained. The apparatus has the merits of both simple construction and low cost. A typical photograph of the Weissenberg type is given, and the method of interpretation outlined. C. J. B. C.

See also Abstracts 4276, 4277, 4331, 4369, 4530, 4581, 4582, 4595, 4600, 4610, 4693, 4695, 4711.

DENSITY.

4314. Molecular Volumes and Expansivities of Liquid Normal Hydrogen and Parahydrogen. R. B. Scott and F. G. Brickwedde. *Bureau of Standards, J. of Research,* 19. *pp.* 237–248, *Sept.,* 1937. *J. Chem. Phys.* 5. *pp.* 736–744, *Sept.,* 1937.—The molecular volumes at saturation of liquid normal H_2 and para-H_2 between 14° and 20·4° K. were measured with a fused-quartz dilatometer, the amount of H_2 being determined from the pressure of the gas in a calibrated flask at a measured temperature. The results are represented by the equations:

$$V(n\text{-}H_2)\ \text{cm}^3\ \text{mole}^{-1} = 24{\cdot}747 - 0{\cdot}08005T + 0{\cdot}012716T^2$$

$$V(p\text{-}H_2)\ \text{cm}^3\ \text{mole}^{-1} = 24{\cdot}902 - 0{\cdot}0888T + 0{\cdot}013104T^2$$

At the normal boiling point of n-H_2 (20·38° K), $V(n\text{-}H_2) = 28{\cdot}397 \pm 0{\cdot}010$ and $\Delta V(p\text{-}n) = 0{\cdot}138 \pm 0{\cdot}010$. The expansivity of p-H_2 is only slightly greater than that of n-H_2. The change observed in the molecular volumes of H_2 in passing from the state in which the molecules rotate (o-H_2) to the state in which they do not rotate (p-H_2) is opposite in direction to the change observed in other substances when passing between these two states of molecular rotation and non-rotation. The changes in "lattice" energies are also of opposite sign. It is shown that the random state of orientation of the axes of p-H_2 molecules makes the state of non-rotating p-H_2 fundamentally like that of rotation in other substances at high temperatures. AUTHORS.

4315. Changes in Density of Silver with Annealing and Cold Working. A. Igata. *Kyoto Coll. Sci., Mem.* 19. *pp.* 215–222, *Sept.*, 1936, *and* 20. *pp.* 35–38, *Jan.*, 1937. *In English.*—The changes in density of pure Ag with heat treatment and with cold working were measured, and their relations are explained. The elimination of minute cavities in the metal is discussed on the basis of the experiments. A criterion value of the density of Ag is proposed.

See also Abstracts **4293, 4594, 4662.**

DIFFUSION AND OSMOSIS.

4316. Diffusion of HCl Through Aqueous Solutions of KCl, NaCl and LiCl. L. J. Burrage and A. J. Allmand. *J. Phys. Chem.* 41. *pp.* 887–894, *June*, 1937.—The diffusion of 0·1 *M* HCl at room-temperature through aqueous solutions of KCl, NaCl and LiCl has been studied, using alkali metal chloride solutions of concentrations varying from 0·05 *M* up to 4·1 to 6 *M*. The values of the diffusion coefficients have been recalculated to a common temperature of 25° C. When plotted against the molarity of the alkali metal chloride, both the diffusion coefficient (K) and the product of the diffusion coefficient and the viscosity of the solution ($K\eta$) yield curves which are different for the three alkali metal chlorides. Nevertheless the $K\eta$ curves are nearly coincident over the concentration range 1 to 3 *M*. The results are discussed from the points of view of (i) the Arrhenius theory of electrolyte dissociation, (ii) the Debye-Hückel theory, and (iii) the extended Onsager theory due to Bennewitz, Wagner, and Küchler. AUTHORS.

4317. Thermal Diffusion in Gas Mixtures. Part II. M. Puschner. *Zeits. f. Physik,* 106. 9–10. *pp.* 597–605, 1937.—In continuation of the work of G. and O. Blüh [see Abstract 3503 (1934)] the thermal diffusion of mixtures of He and Ne and of He and A is investigated. From these measurements the law governing the repulsive force between the molecules is derived. For Ne this force is proportional to the inverse 10th power of the molecular distance, whilst the inverse 15th power holds for A. The two mixtures differ in that whereas for He—Ne the ratio of the theoretical to the experimental value of the diffusion coefficient is practically independent of the relative proportions of the gases, for the He–A mixture the ratio decreases as the percentage of He is increased.
R. W. P.

4318. Experimental Study of Turbulence Diffusion. E. G. Richardson. *Phys. Soc., Proc.* 49. *pp.* 479–492, *Sept.* 1, 1937.—This paper describes a method of studying the rate of diffusion, due to the turbulence prevailing in a stream, of a dye let into the stream. The concentration of the dye is measured with a beam of light and photoelectric cell, and the stream-velocity with a hot-wire anemometer, at various places in the stream. As a test of the method the latter is first applied to molecular diffusion and shown to give results in accordance with those obtained by other methods. Next, turbulence induced in a water channel by gratings of various mesh-widths is traced. By using a pair of sources and light-beams with associated photoelectric cells, the degree of correlation between the motions at two points in the turbulent stream, both along and across it, can be studied. Finally, the diffusion due to turbulence of the dye-source at the head of a plate edge-on to the stream is studied. Smooth plates and those having a sinusoidal roughness are used. It is found that both the velocity-distributions and the rates of diffusion can be expressed in terms of a Blasius parameter and a factor dependent on the wave-length of the roughness. AUTHOR.

4319. Dependence of Osmotic Pressure on Temperature and Molecular State in High-Molecular Solutions. G. V. Schulz. *Zeits. f. phys. Chem.* 180. *Abt.A.* 1. *pp.* 1–24, 1937.—In an ideal solution the osmotic pressure must be proportional to the absolute temperature. If the dissolved molecules are associated in a manner dependent on the concentration, then the osmotic pressure must be more than proportional. It is shown that in 1–3% solutions of nitro-cellulose in acetone and poly-styrol in xylol the osmotic pressure increases with temperature at a less rate than linear. It appears also that there is no perceptible association in the concentration range though in every case there is departure from the ideal state. The temperature coefficient of osmotic pressure decreases with increasing concentration. The heat of dilution is calculated from the variation of the osmotic pressure with temperature. In 2–3% solutions this is already more than half of the total work of dilution. The relation between the heat of solution, the heat of dilution and the association of high and low molecular weight materials is discussed. From an investigation of the influence of temperature and molecular weight on the osmotic pressure it seems likely that at vanishing concentrations the equation of van t'Hoff is valid. The high-molecular solutions investigated here were neither ideally diluted nor ideally concentrated. By considering an approximation in the sense of v. Hildebrand, the departure from the van t'Hoff law, can be attributed in the first instance to the energetic reciprocal action between the solute and the solvent. The dilution entropy is about 40–50% of the ideal value. Thermodynamic and extra-thermodynamic theories on high-molecular solutions are considered. E. H. D.

See also Abstract 4616.

ELASTICITY AND PLASTICITY.

4320. Solution of the Plane Problem of the Elasticity of Anisotropic Material for the Interior of an Ellipse. S. Lechnitsky. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 15. 9. *pp.* 535–538, 1937. *In French.*—The formal solution in the case of given stresses along the boundary is worked out, and that for given displacements can be similarly obtained. W. G. B.

4321. Boundary Dynamic Problem of the Theory of Elasticity for a Circle with Given Displacements. J. A. Mindlin. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 15. 9. *pp.* 531–534, *and* 16. 1. *pp.* 15–18, 1937. *In English.*—The problem of the plane motion of a circular disc due to prescribed stresses or displacements along the circumference is reduced to a set of integral equations, which are formally solved. W. G. B.

4322. Design of a Spherical Shell. V. Sokolovskij. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 16. 1. *pp.* 19–24, 1937. *In English.*—On the assumption that linear elements perpendicular to the undisplaced middle surface remain linear and perpendicular to the middle surface after displacement, the formal solution of the problem of a portion of a spherical shell bounded by parallels and meridians, and subject to forces and couples along its edge, is obtained. W. G. B.

4323. Theory of Continuous Beams and Plane Elastic Frames. L. Broglio. *Ricerche di Ingegneria,* 5. *pp.* 58–74, *May–June,* 1937.—A general theorem is developed for the forces on a continuous beam. From the results is obtained, by the theory of matrices, a new method of calculating beams and elastic frames without movement at the joints. Some numerical examples are given to demonstrate the speed and convenience of the proposed method. R. F. A.

4324. Stresses in Helices and Arcuate Beams. R. Giovannozzi. *Ricerche di Ingegneria,* 5. *pp.* 75–88, *May–June,* 1937.—Some calculations are given for bodies of constant section but curved axes to determine approximately the influence of the curvature on the displacements under axial, bending, and torsional loads. The results are applied to a helical structure of six turns supported at its ends and subjected to concentrated or distributed loads parallel to the axes. A horizontal beam in the form of a circular arc built in at the ends is also considered. R. F. A.

4325. Theory of the Beam with a Curved Axis. G. Fubini. *Accad. Sci. Torino, Atti,* 72. *Disp.* 3*a*. *pp.* 386–410, *April–Oct.,* 1937.—A mathematical paper dealing with the theory of the beam with a curved axis, a problem which is analogous to the Saint Venant problem in the theory of the beam with a rectilinear axis. C. J. B. C.

4326. Approximate Solution of Buckling Problems. A. N. Procter. *Engineering,* 144. *pp.* 62–64, *July* 16; 116–118, *July* 30, *and pp.* 184–186, *Aug.* 13, 1937.—The least-energy methods of Timoshenko are applied to simple cases and, by extension, to more complex cases of columns and beams, including braced members, beams carrying filler beams and asymmetrical sections. Approximate expressions for the permissible stresses are given, together with curves derived therefrom.

R. F. A.

4327. Elastic Stability of a Long and Slightly Bent Rectangular Plate under Uniform Shear. D. M. A. Leggett. *Roy. Soc., Proc.* 162*A*. *pp.* 62–83, *Sept.* 1, 1937.—A long plate, slightly curved, is subjected to a shearing force applied uniformly along its two straight edges. A theoretical investigation is carried out to ascertain the value of the shearing force at which buckling of the plate may be expected to take place. Two cases are investigated, in one of which the two straight edges are simply supported, and in the other of which they are clamped. The results of the investigation, giving the critical shearing force in terms of the dimensions of the plate in each of the two cases considered, is shown graphically.

AUTHOR.

4328. Atomic Forces of the Solid State. Part VI. Weng Wen-Po. *Phil. Mag.* 24. *pp.* 466–472, *Sept.,* 1937.—This mathematical paper continues previous work [see Abstract 478 (1937)] and deals with non-metals. Lindemann's and Gruneisen's formulæ for metals are shown to apply to non-metals also, and their characteristic atom vibrational frequency for the solid state is calculated from various physical data. Tables are given of data for : A, Br, Cl, I, N, O, Ne, He, Si, F, C_{dia}, B, H, and CO. A section on general theory concludes the paper. H. H. Ho.

4329. Measurement of Elastic Constants by Supersonic Excitation. L. Bergmann. *V.D.I.* 81. *pp.* 878–882, *July* 24, 1937.—A description is given of the method of determining elastic constants by supersonic excitation. The advantages claimed for the method are : increased accuracy and simplicity ; the possibility of determining all the elastic constants from one set of observations ; no special form of test-piece is required; there is no restraint upon the specimen during the measurement; the specimen can be in an enclosure. J. E. R. C.

4330. Plastic Surges. G. Peretti. *Accad. Lincei, Atti*, 25. *pp.* 371–376, *April* 18, 1937.—Finzi [see Abstract 4507 (1936)] has given a solution relating to the motion induced by a vortex in a system which is plastic and viscous. In this paper a discussion is given of a parallel case relative to the motion provoked in a fluid of the same nature by a surge. Finzi's paper relates to "plastic rotations" defined as the motion external to a rigid cylinder immersed in a plastic system and rotating about its own axis. The author discusses a further application to a case complementary to this. The motions correspond practically to those induced by a surge in a perfect fluid, and to those that Hamel calls "radial currents" in viscous fluids. J. J. S.

4331. Dynamics of Plastic Deformation. A. Kochendörfer. *Zeits. f. Krist.* 97. 4. *pp.* 263–299, 1937.—An examination is made of the behaviour of single crystals of naphthalene subjected to various stresses. The crystals are cylindrical and the method of preparing them is described. The results obtained hold qualitatively for all plastic materials. J. T.

4332. Flow of Metals. E. N. da C. Andrade. *Inst. of Metals, J.* 60. *pp.* 427–445, 1937.—Flow is most easily observed in the liquid state, but the structure of the liquid state is still obscure. Nevertheless it is possible on simple lines to formulate a theory of liquid viscosity, which both gives the observed viscosity of simple liquids and accounts for the temperature variation. In this connection viscosity of liquid metals is important, on account of the simplicity of the molecular state. The flow of solids is best observed in single crystals of metals. Certain general laws have been formulated, from which it is clear that the velocity of flow is of fundamental significance. The perfect crystal lattice does not offer a basis for any theory of the flow of solids: the only successful attempts to construct a mechanism to explain plastic behaviour are based on the assumption of flaws, or dislocations, in the lattice, which are propagated along preferential directions when external stresses are applied. Thermal fluctuations must also be invoked. Further investigation of the nature of the inherent flaws is of importance, not only for physical theory but also for metallurgical practice. AUTHOR.

***4333. Glass Cutting. M. W. Jones and J. M. Blair.** *J. of Applied Physics*, 8. *pp.* 627–629, *Sept.*, 1937.—Glass plates were found to be more difficult to break when an interval elapsed between marking and breaking. This was associated with a decrease in the strain. Apparatus for applying uniform force in marking glass is described; also, a device for studying breaking loads. Marked samples of glass were found to break when subjected to diminished loads for appreciable intervals. A correlation was shown between the breaking load and the load on the marker. AUTHORS.

4334. Elastic After-Effect. Schlötzer. *Zeits. f. Instrumentenk.* 57. *pp.* 371–378, *Sept.*, 1937.—Satisfactory operation of many instruments depends on the use of springs. Apart from the well-known effect of temperature variations upon the elastic properties of spring materials, alteration in elastic properties of a spring may follow a change in its tension, thus introducing a zero error in spring-controlled pointer instruments or a change of rate in clocks. An experimental investigation of this after-effect is described in which two similar clock springs of spiral form were set free and floated in a mercury trough after being kept wound up for a long time. Subsequent changes in shape of the springs due to after-effect were recorded at succeeding intervals of time by photographic means. An empirical relation is found between the magnitude of movement of a fixed point on a spring, the distance of this point from the inner end of the spring and time. The after-effect may persist for 3 to 5 months before an approximately steady condition is attained. H. B.

See also Abstracts 4347, 4368, 4378, 4617, 4630.

GRAVITATION.

4335. Gravity Measurement at Sea. B. C. Browne. *Roy. Astron. Soc., M.N., Geophys. Supplement,* 4. *pp.* 271–279, *Sept.,* 1937.—General results are deduced first for a ship at rest without reference to any particular type of gravimeter. It is shown that to obtain the true value of gravity from measurements made on board a moving ship it is necessary to know at each instant the direction of the resultant acceleration due to the ship's motion and the direction of the vertical with respect to the axis of the gravimeter. It is pointed out that the conclusions reached by Meinesz with the pendulum type of apparatus are only approximate but by applying two small corrections agreement is obtained. It is concluded that earlier values of gravity are generally too high by several milligals. The order of magnitude of this correction is obtained and under working conditions it may reach 32 milligals but data exist to make a more correct estimate. R. S. R.

HYDRODYNAMICS AND AERODYNAMICS.

4336. Rotational Motion of Gases. C. Possio. *Accad. Lincei, Atti,* 25. *pp.* 455–461, *May* 8, 1937.—Having previously discussed the problem of the permanent rotational motion of a perfect compressible fluid, limited to the case of motion in two dimensions, the author deals in the present paper with the general case of permanent motion in three dimensions. J. J. S.

4337. New Family of Wing Profiles. N. A. V. Piercy, R. W. Piper, and J. H. Preston. *Phil. Mag.* 24. *pp.* 425–444, *Sept.,* 1937.—A new family of symmetrical and cambered streamline sections have been mapped from the circle by a sequence of conformal transformations. The shapes obtained are suitable for the sections of wings, struts, fins, and airscrew blades; judged by modern aeronautical practice they appear, indeed, to approach perfection in this respect, and to represent a distinct advance on earlier transformed profiles of slender form. They also generate a reduced pitching moment. The new profiles are convenient to handle analytically, and may be traced by simple mechanical means. It appears probable that a modification can be introduced to yield a stationary centre of pressure, if desired, without losing the benefit of conformal transformation. This possible development is under investigation. AUTHORS.

4338. Kinetic Interaction between Vortices and Irrotational Currents. G. Lampariello. *Accad. Lincei, Atti,* 25. *pp.* 444–450, *May* 8, 1937.—Demonstration of a general property concerning the kinetic energy of a liquid in motion round a fixed solid, when to the irrotational current, translatory to infinity, there is superposed the most general distribution of velocity induced by vortices. J. J. S.

4339. Equations of Motion of Perfect Fluids. F. Paderi. *Ricerche di Ingegneria*, 5. *pp.* 57–58, *May–June*, 1937.—These equations are given in a form suitable for application in practice. R. F. A.

4340. Potential Flow with Constant Velocity. G. Hamel. *Preuss. Akad. Wiss. Berlin, Ber.* 2. *pp.* 5–20, 1937.—In two dimensions the only possible steady motions of an inviscid incompressible fluid for which the velocity is constant along every streamline are motions in straight lines or circles. In three dimensions the necessary and sufficient condition is that the equi-potential surfaces should be minimal surfaces, and it is proved that the only solution is that these surfaces should be helicoids. S. G.

4341. Two-Dimensional Potential Theory. Part V. Generalised Formulæ for the Forces and Couple on a Moving Cylinder. Rosa M. Morris. *Phil. Mag.* 24. *pp.* 445–453, *Sept.*, 1937.—In continuation of previous work [see Abstract 3387 (1937)] it is shown that there are generalised forms of the simple Blasius formulæ applicable to the case of a cylinder moving in any manner in a fluid, and these enable the forces and couple on the cylinder to be simply evaluated. The formulæ involve the complex potential function and the variables defining the motion of the fluid and cylinder. They are applied to the case of an elliptic cylinder moving with velocity components u and v along axes on a normal cross-section of the cylinder, and having an angular velocity, w, about a normal to this section; the motion also includes a variable circulation round the cylinder. Results corresponding with those given by Glauert are obtained. J. S. G. T.

4342. Velocity Distribution in Turbulent Flow in Pipes. V. A. Gavrilenko. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 15. 8. *pp.* 441–443, 1937. *In English.*—A comparison of the author's theory [see Abstract 4526 (1936)] with experimental results, due to Nikuradse, in smooth and rough circular pipes and in a rectangular pipe. S. G.

4343. Turbulent Flow along Walls Having Wave-Forms. H. Motzfeld. *Zeits. f. angew. Math. u. Mechanik*, 17. *pp.* 193–212, *Aug.*, 1937.—Turbulent flow along four different walls was investigated. Two of the walls were sinusoidal; one was nearly trochoidal; and the section of the fourth consisted of circular arcs meeting at angles of 120°. In each case the pressure distribution along the wall and the velocity distribution in its neighbourhood were measured, and the resistance, the distribution of shear stress, and the stream lines deduced. The results of the pressure measurements are applied to a discussion of the production of water waves by the wind. S. G.

4344. Solution of Oseen's Equations for an Inclined Elliptic Cylinder in a Viscous Fluid. D. Meksyn. *Roy. Soc., Proc.* 162*A*. *pp.* 232–251, *Sept.* 15, 1937.—The equations of motion of a viscous fluid round an inclined elliptic cylinder have been solved by Oseen's approximation, the solution being expressed in Mathieu functions. The complete stream function for no slipping on the surface of the cylinder has been found and formulæ for lift and drag at very small Reynolds numbers <4 have been obtained. It remains for the future to extend the computations to larger values of Reynolds number. Incidentally, an expression is found for Green's function for a plane external to an ellipse. For an ellipse with the ratio of major and minor axes of 1·25 and Reynolds number 3·3 the calculated values of the lift and drag coefficients and the ratio of lift to drag are shown. A maximum lift coefficient of about 1·7 is reached at an angle of incidence of 45°. The drag increases continuously with increase of angle of incidence and the ratio of lift to drag has a maximum of about 0·22 at an incidence of 39°. Whilst no experimental results exist for such small Reynolds numbers the general type of curve is that for aerofoils. AUTHOR.

See also Abstracts 4318, 4330.

KINETIC THEORY OF MATTER.

4345. Velocity Analysis by the Stern-Gerlach Effect. V. W. Cohen and A. Ellett. *Phys. Rev.* 52. *pp.* 502–508, *Sept.* 1, 1937.—A Stern-Gerlach experiment furnishes a convenient method of studying the velocity distribution in a molecular beam. In addition it is possible to obtain some information concerning the behaviour of the field gradient as a function of position. This method has been applied to a beam of alkali atoms and shows that with low vapour pressure in the oven the Maxwell distribution law is fulfilled whereas at oven pressures such that the mean free path is much less than the width of the oven slit a departure sets in. It is found that the field gradient is quite uniform over almost half the trough height for deflections inside the trough. Toward the wedge the gradient varies rapidly. [See following Abstract.] AUTHORS.

4346. Velocity Analysis of Potassium Atoms Scattered by Magnesium Oxide. A. Ellett and V. W. Cohen. *Phys. Rev.* 52. *pp.* 509–512, *Sept.* 1, 1937.—A beam of K atoms is scattered by an MgO crystal and the magnetic velocity analyser used to determine the distribution in velocity of the scattered atoms. The resulting velocity spectrum agrees very well with that calculated on the assumption of a Maxwell distribution characteristic of the temperature of the crystal although the crystal temperature was varied over a wide range. A rough study made of the spatial distribution of the scattered atoms showed no evidence of specular reflection or of diffraction but merely random or cosine scattering. The scattering process appears to be one of adsorption and re-evaporation. [See preceding Abstract.] AUTHORS.

***4347. Torsion Manometer for the Measurement of the Force of a Molecular Ray. M. J. Copley and V. Deitz.** *Rev. Sci. Instruments,* 8. *pp.* 314–317, *Sept.,* 1937.—The construction and operation of a torsion manometer for the measurement of the force exerted by a molecular ray is described. The manometer was used to measure the vapour pressures of KCl and CsI crystals in the range of temperature 800–950° K. The results obtained suggest that it is possible to develop this method to a degree where it will yield data at least as accurate as that obtained by other methods. Some applications of the torsion manometer are discussed. AUTHORS.

See also Abstracts 4317, 4375, 4376, 4687.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

***4348. Combined Mirror and Lever Extensometer. M. Sugihara.** *Kyoto Coll. Sci., Mem.* 20. *pp.* 19–26, *Jan.,* 1937. *In English.*

See also Abstracts 4417, 4585.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

4349. Graphical Integration of Differential Equations in Electrical Technology. P. Böning. *Arch. f. Elektrot.* 31. *pp.* 545–551, *Aug.* 10, 1937.—Examples are shown illustrating the solution of switching-in phenomena of inductive resistances in a.c. circuits, both with constant inductance and with iron-cored inductance. The method is based on an integration by H. Heinrich of differential equations of the form $y' = [A_1 f_1(x) + B_1 g_1(y) + C_1]/[A_2 f_2(x) + B_2 g_2(y) + C_2]$. M. G. S.

4350. Isotropic Tensors of Certain Symmetry Properties. G. Racah. *Accad. Lincei, Atti,* 25. *pp.* 475–480, *May* 8, and *pp.* 615–621, *June* 4, 1937.

4351. Orderly Structure of Statistical Series of Exponential Type. M. Ferber. *Comptes Rendus,* 205. *pp.* 381–383, *Aug.* 18, 1937.—In the study of any statistical series the problem usually set is to discover if the observed frequencies correspond with the presumed theoretical distribution. But it may equally be asked if the arrangement of the observed magnitudes is completely disorderly, or on the contrary shows regularly ordered sequences. For treating this second question recourse is had to "determined selections" amongst the magnitudes observed, selections which vary in nature according to the problems to be solved. The object of the present paper is to show that already in every theoretical distribution the density of probability $f(x)dx$ suffices to determine implicitly a certain type of order in the course of the chance magnitudes and that this type can be expressed by a single value. J. J. S.

4352. Electromagnetic Magnitudes and Units. E. Brylinski. *Soc. Franç. Élect., Bull.* 7. *pp.* 817–846, *Aug.*, 1937.—The c.g.s. system is inherently a system of units of length, mass and time, but any number of other systems of the same type can be formed by changing the units of the magnitudes concerned. The logical basis is the system of magnitudes. By judicious choice of magnitudes, and without making any hypothesis on the nature of the dielectric constant (ϵ_0) and magnetic permeability (μ_0) of a vacuum, both of which quantities disappear from the equations, it is possible to take as fourth fundamental magnitude the speed c of light, which is a characteristic of the electromagnetic medium but of mechanical nature, so that all the magnetic and electrical magnitudes can be derived from the fundamental mechanical magnitudes. The relation $c=1/\sqrt{\epsilon_0\mu_0}$ makes it sufficient to add one electrical or magnetic magnitude to the fundamental mechanical magnitudes to construct a complete system. By substituting a magnetic mass $m' = m/\sqrt{\mu_0}$ for m in the general expression of Coulomb's law, expressions for magnetic and electrical magnitudes are obtained without μ_0 and ϵ_0. Consideration of the resultant systems of units leads to the conclusion that the system developed is not suitable for general use because it would exclude certain units which it is desirable to keep. The author elaborates his arguments in a discussion. A note by **A. Lartigue** refers to his earlier development of the thesis that electrical and magnetic magnitudes can be expressed as functions of three mechanical fundamental magnitudes. R. E. N.

***4353. Instrument for Evaluating Stieltjes Integral. E. J. Nyström.** *Soc. Scien. Fennica, Comm. Phys.-Math.* 9. 4. [18 *pp.*], 1937. *In German.*—In problems leading to an integral a direct empirical function often exists which can be evaluated between two limits by a planimeter, but integrals frequently occur, called Stieltjes integrals, of the form

$I = \int_{t_1}^{t_2} f(t) \cdot h'(t) \cdot dt = \int_{t_1}^{t_2} f(t) \cdot dh \cdot t$, where $f(t)$ or $h'(t)$ are empirical or formally given functions. These occur for integration over an interval with irregular distribution of mass, pressure, illumination or electricity. Details are given of the Stieltjes planimeter with some practical applications of its use. R. S. R.

***4354. Curve Tracer for Two, Three or Four Variables. H. Awender and D. M. Tombs.** *Rev. Sci. Instruments*, 8. *pp.* 274–278, *Aug.*, 1937.—Describes a curve tracer which enables the relation between 2, 3 or 4 variables to be observed and recorded. An optical system projects the image of an L-shaped aperture on to a screen. By means of mirrors attached to two of the measuring instruments, the image of the aperture may be moved to any point on the screen depending on the deflection of the instruments. By means of light shutters attached to two other instruments, the lengths of the arms of the L-shaped aperture are determined by the deflections of these instruments. Thus the apparatus provides a 2-coordinate system (the image of the L-shaped aperture) moving within a second 2-coordinate system (the screen) whereby the inter-relations between 2, 3 or 4 variables can be observed whilst one or more of the variables is altered. J. S. C.

See also Abstracts 4339, 4341, 4360, 4588, 4638, 4646, 4665.

MECHANICS, CLASSICAL.

See Abstracts 4365, 4383, 4384, 4385.

MECHANICS, QUANTUM.

4355. Second Quantisation of Dirac's Equation. D. Iwanenko and A. Sokolow. *Phys. Zeits. d. Sowjetunion*, 11. 6. *pp.* 590–596, 1937. *In German.*—Summary of the formulæ of the many electron problem in Dirac's theory. The difficulties of the theory are compared with those which would occur in a theory in which the electron had a spin but would satisfy Bose-Einstein statistics. R. P.

4356. Generalisation of the Equations of Dirac for the Space of General Relativity. C. Tolotti. *Accad. Lincei, Atti*, 25. *pp.* 377–382, *April* 18, 1937.—A re-examination of the commonly accepted extension of Dirac's equations in view of the difficulty pointed out by Levi-Civita and others which compels the introduction in the space-time system of an auxiliary network (consisting of four congruents of lines mutually orthogonal) which as a purely mathematical expedient without physical significance should not have substantial influence on the final equations. J. J. S.

4357. Effects of Polarisation on the Dirac Electron. G. Wannier. *Arch. des Sciences*, 19. *pp.* 111–118, *May–June*, 1937.—By the use of quadrivectorial algebra some general properties of certain electronic processes are deduced. It is shown, *e.g.*, that neither the diffraction of light nor the "Bremsstrahlung" of an electron depend on the spin of the electron. Similarly the creation of a pair by an electron does not depend on the spin of the latter, provided the effects of exchange may be neglected. G. O. B.

4358. Foundations of Quantum Mechanics. Part I. K. Husimi. *Phys. Math. Soc., Japan, Proc.* 19. *pp.* 766–789, *Aug.*, 1937. *In English.*—An attempt is made to develop quantum mechanics on an axiomatic basis. R. P.

4359. Interaction of Two Particles in Relativistic Wave Mechanics. J. L. Destouches. *J. de Physique et le Radium*, 8. *pp.* 251–256, *June*, 1937.—From a generalisation of the Lorentz transformation it is shown that the principle of superposition of forces follows from relativity conditions, and, using the conditions of invariance imposed by relativity, a form of interaction of two Dirac particles satisfying the required conditions is obtained. This result establishes the existence of a relativistic wave mechanics of systems of particles. It is shown also that the radius of the electron appears in the expression for the interaction of an electron and a neutrino, and that the problem of the interaction of two electrons cannot be treated relativistically as a problem of the mechanics of two particles. [See Abstract 3412 (1937).] N. M. B.

4360. Quaternion Treatment of the Relativistic Wave Equation. A. W. Conway. *Roy. Soc., Proc.* 162*A*. *pp.* 145–154, *Sept.* 15, 1937.—The Dirac equations for the electron are thrown into quaternion form and their exact solution deduced. The quaternion method, it is suggested, has the advantage of being simpler than the usual matrix method. G. C. McV.

4361. Applications of the Kirchhoff-Dirac Function to the Solution of the Classical Wave Equation. T. Lewis. *Phil. Mag.* 24. *pp.* 329–360, *Sept.*, 1937.—Use is made in this paper of the Kirchhoff-Dirac function to prove a number of theorems involving solutions of the classical wave equation. The function in question $\delta(x)$ is defined by Dirac as a function which is everywhere zero except at $x = 0$ where it is infinite to such an extent that $\int_{-\infty}^{\infty} \delta(x)dx = 1$. Kirchhoff's function $K(x)$ is similar except that the function is taken as zero outside a region $\pm\delta$ where δ is an arbitrarily small quantity. After discussing the properties of $\delta(x)$ and their validity when $\delta(x)$ is replaced by $K(x)$, the author goes on to prove various formulæ, such as the Poisson-Liouville formula, proved directly, and also its two dimensional analogue; while a solution of the wave equation is obtained which reduces to prescribed functions at the instants t_1 and t_2. In the second part of the paper, the convenience of the function $K(x)$ is shown for the representation of electromagnetic potentials and field intensities. Amongst other formulæ, a form of the Lagrangian of two interacting electrons is obtained, which reduces to Darwin's approximate form and which is taken as the basis of the quantum theory of two interacting electrons. G. O. B.

4362. Fine-Structure Formula of Sommerfeld and Electron Spin. S. C. Kar. *Zeits. f. Physik*, 106. 7–8. *pp.* 418–422, 1937.—A wave-mechanical interpretation is given. W. R. A.

4363. Theory of Nuclear Forces. A. March. *Zeits. f. Physik*, 106. 7–8. *pp.* 532–538, 1937.—The author further develops his theory [see Abstract 3408 (1937)] of the space occupied by the ultimate particles of matter which is based on the introduction of a universal infinitesimal length γ. He now shows that γ can be calculated from the proton-neutron force in the theory of the nucleus. The value of γ is approximately equal to that of the classical electron-radius. G. C. McV.

4364. H-Theorem in Quantum Mechanics. W. Pauli and M. Fierz. *Zeits. f. Physik*, 106. 9–10. *pp.* 572–587, 1937.—The proof of the fundamental theorem of statistical mechanics, that the average behaviour of a system over a long time is equal to the statistical average, is discussed on the basis of a theory of v. Neumann. One has to assume that a macroscopic observer can measure the coordinates of the system only with certain limits of error. Even then it is not possible to prove that for any such observer the H theorem will necessarily be true, but one can show that it is probably true, in the sense that amongst all possible observers the number of those for which it will not hold, is very small. R. P.

See also Abstracts 4240, 4241, 4264, 4502, 4516, 4685, 4686, 4692.

RELATIVITY AND ETHER.

4365. Poincaré's Principle of Relativity and Leroux's Invariant Mechanics. P. Dive. *Arch. des Sciences*, 19. *pp.* 119–165, *May–June*, 1937.—An invariant mechanics, more general than Newton's, is developed from Poincaré's ideas on geometry and dynamics. An invariant function is defined as one which retains its form, as well as its value, under a transformation of co-ordinates belonging to a given group. Dynamics is reduced to relations between the distances separating the elements of a system and the variation of these distances, which are all invariants in the above sense. G. C. McV.

See also Abstracts 4356, 4359, 4506.

SOLUTION.

4366. Structure in Electrolytic Solutions. P. Debye. *Frank. Inst., J.* 224. *pp.* 135–144, *Aug.*, 1937.—The paper is a review of the theory of electrolytic solutions, and traces step by step, the development of the present knowledge. The author links up his own and his collaborateur's contributions to the subject with the classical theory. F. J. B.

4367. Solvent Balance of a Solvent-Diluent Mixture. J. K. Stewart, J. B. Dorsch and C. B. Hopper. *Indust. and Engin. Chem.* 29. *pp.* 899–904, *Aug.*, 1937.—The relative rates of evaporation of the thinner ingredients in solvents have been suggested as providing a means of estimating solvent balance during the evaporation of a lacquer-thinner from a film, and this paper investigates two mixtures with the above objective. Mixture A was composed of butyl acetate, butyl alcohol, and toluene, while mixture B contained butyl acetate, butyl alcohol, toluene and a petroleum diluent (Troluoil). The samples were respectively evaporated 25, 50 and 75%, and the rate of evaporation of butyl acetate in terms of itself showed the least variation. The toluene-Troluoil mixture apparently evaporated at a greater rate than toluene alone. Based on the assumption that each ingredient would evaporate from the mixture at the relative rate of evaporation of that ingredient alone, the compositions of the samples were calculated; fair agreement between the found and calculated values was obtained except for Troluoil. Upon evaporation, the mixture containing Troluoil developed an increasing tolerance at a more uniform rate than in the case of the mixture containing only toluene as the diluent. H. H. Ho.

4368. Compressions of Solutions of Salts in Water, Glycol and Methanol. R. E. Gibson. *Am. Chem. Soc., J.* 59. *pp.* 1521–1528, *Aug.*, 1937.—From data for the specific volumes and compressions of solutions of NaBr, NaI, KI, LiBr and CaI_2 in methanol, glycol and water, apparent volumes and compressions and effective pressures are computed. The apparent volumes of CaI_2 in aqueous solution varied with concentration in a manner different from that described in the literature. The aqueous and non-aqueous solutions show a general similarity of behaviour under pressure, but certain differences are examined and discussed. The partial volumes of the salts in different solvents at different pressures are examined and general conclusions on the course of pressure-solubility curves are drawn. N. M. B.

See also Abstracts 4371, 4612.

SURFACE TENSION AND COHESION.

4369. Theory of Expanded Film. K. Ariyama. *Chem. Soc., Japan, Bull.* 12. *pp.* 335–337, *July*, 1937.—The following explanation is proposed for the sudden appearance of the expanded state: according to the theory of Langevin-Weiss, an ensemble of molecules with permanent magnetic moment or electric moment can exhibit the "ferromagnetic state," and there is a sharp critical temperature at which the transition from paramagnetic to ferromagnetic state takes place. The author considers that the "ferromagnetic state" is also possible for two-dimensional states and he applies to it Born's explanation for the existence of the sharp critical temperature at which the anisotropy of a liquid crystal disappears, when the critical volume of the molecule is found to vary inversely as the temperature *viz.*: $V_e = {}^1/N = 4\pi\ \mu^2/9kT$, where μ is the electric moment of the molecule. From this equation the electric moment of myristic acid is found to be $2{\cdot}5 \times 10^{-18}$. H. H. Ho.

4370. Effect of Amino-Acids on the Surface Tensions of Sodium Chloride Solutions. J. W. Belton. *Faraday Soc., Trans.* 33. *pp.* 1176–1180, *Sept.*, 1937.—The surface tensions of ternary solutions containing sodium chloride at concentrations from 0–4 *M* and saturated with respect to the following amino-acids—aspartic acid, asparagine, glutamic acid, *o*-, *m*-, and *p*-amino-benzoic acids—have been measured by the bubble pressure method. The acids produce very little effect on the surface tension of water, but a more marked effect as the concentration of salt increases. The surface tension-salt concentration curve is in all cases a straight line of slope less than that for pure salt solutions. It is shown that under the experimental conditions the activities of the undissociated acid and the ions derived from it are approximately constant, which allows the surface concentrations of water to be calculated by means of the Gibbs equation. In all cases it is found that the presence of amino-acid reduces the amount of water adsorbed. The results are discussed from the standpoint of the zwitterion theory. [See also Abstract 1553 (1937).] AUTHOR.

4371. Properties of Detergent Solutions. J. Powney and C. C. Addison. *Faraday Soc., Trans.* 33. *pp.* 1243–1260, *Sept.*, 1937.—Surface tension data for dilute solutions of paraffin-chain sulphates have been determined by the ring method, and are recorded over a wide range of temperature. Interfacial tensions against xylene have been measured by the drop weight method, and are recorded for the same salts at 60° C. Interfacial tensions for sodium dodecyl sulphate solutions are given over the temperature range 20°–75° C. Both surface and interfacial tension curves show well defined breaks at certain critical concentrations. The nature of the surface active species, and the equilibrium between simple long-chain ions and micelles, are discussed with particular reference to the work of Murray and Hartley. The influence of chain length on the temperature coefficients of both surface and interfacial tensions and critical concentrations are discussed, and the various disturbing factors which render inadvisable the application of Gibbs' equation to data for these solutions are given. The effect of various added salts on the surface and interfacial tensions of long-chain alkyl sodium sulphates has been studied. It is shown that the surface activity and the critical concentration for micelles are modified to an extent which is dependent upon the valency of the added kation, and independent of the nature of the associated anion. The magnitude of these effects is also governed by chain length and temperature. The mechanism whereby surface activity is influenced by added electrolytes is discussed. AUTHORS.

4372. Kinetics of Wetting and Linear Corrosion of Metals in Polyphase Systems. Part III. D. I. Mirlis. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 15. 8. *pp.* 463–467, 1937. *In English.*—In a preceding communication [see Abstract 2983 (1937)] it has been shown that the corrosion of metals in the systems metal-liquid-liquid and metal-liquid-gas is of a linear nature. The purpose of the present paper is the study of the relation which the character of this linearity bears to the dispersity of the metal surface and to other factors. It has been shown that the linear selective corrosion of Al in the systems metal-liquid-liquid and metal-liquid-gas is directly dependent upon the dispersity of the metal surface. Apart from the great theoretical interest, this conclusion is highly important for the struggle against the most dangerous kind of local corrosion encountered in aircraft manufacture and other Al consuming branches of industry. It is experimentally ascertained that the line of contact between a metal and other phases is the source of numerous corrosion centres. The experimental material obtained points to the possibility of extending the classification of corrosion processes, advanced by V. A. Kistiakovskij for Fe, to other metals. J. E. B.

See also Abstracts 4263, 4281, 4282, 4328, 4684.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

See Abstract 4334.

VACUA, HIGH.

✱**4373. Self-Fractionating Oil Diffusion Pump. A. E. Lockenvitz.** *Rev. Sci. Instruments,* 8. *pp.* 322–323, *Sept.*, 1937.—A six-stage oil diffusion pump is described, using ordinary lubricating oil which is fractionally distilled in the pump so that a vacuum of 10^{-6} mm. can be obtained without the use of vapour traps. AUTHOR.

✱**4374. Machined Metal Stuffing Box Seals Adapted to High Vacuum Technique. L. P. Garner.** *Rev. Sci. Instruments,* 8. *pp.* 329–332, *Sept.*, 1937.—Vacuum seals machined from metals and adapted to vacuum technique are described and shown in several forms suitable for joining metals and glass components. Precautions in construction and use are given. Dimensioned working drawings for several sizes of one type are shown. AUTHOR.

✱**4375. Low-Pressure Radiometer Manometer. E. Fredlund.** *Ann. d. Physik,* 30. 1. *pp.* 99–112, *Sept.*, 1937.—The accuracy of the Knudsen radiometer manometer at low temperatures is considered in relation to the treatment of the walls and the sheet and the distance apart of the walls. If the accommodation coefficients of the various surfaces are not the same large errors may arise. A detailed description is given of a new and very sensitive manometer and accessories and of the experimental methods. The pressure measurement is by an electrical compensation method. It is not measured directly in the first place but is calculated from the partial volumes, a pipette system being used. The estimated accuracy is about 2 × 10^{-7} mm. Hg and this could possibly be increased. It appears, however, that the accommodation coefficient enforces a variation of the sensitivity with the gas used. E. H. D.

VISCOSITY, FRICTION AND LUBRICATION.

4376. Molecular Viscosity of Liquids. S. I. Wawilow. *Acta Physicochimica*, 7. 1. *pp.* 49–64, 1937. *In English.*—The effective particle radius r and the viscosity η occurring in the hydrodynamical formulæ given in this paper for the diffusion coefficient, for the viscosity change and for the relaxation time should, on purely hydrodynamical grounds, be different from the gas-kinetic radius of the molecule and from the macroscopic value of viscosity η'. The simultaneous examination of the equation of diffusion with that of viscosity change affords the possibility to determine the effective values of the radius r and of the molecular viscosity η by experiment. The application of the Einstein viscometric equation to the experimental data concerning the dependence of viscosity on temperature and pressure permits of calculating the effective radius r practically independently of the viscosity. The distinction between the molecular viscosity η and the macroscopic one η' is made use of for the explanation of fluorescence quenching phenomena in liquid media. AUTHOR.

4377. Viscosity as Function of Temperature and Pressure. R. H. Ewell and H. Eyring. *J. Chem. Phys.* 5. *pp.* 726–736, *Sept.*, 1937.—An equation for the viscosity of a liquid in terms of the energy of vaporisation and the molal volume is developed from Eyring's reaction rate theory of viscosity [see Abstract 2303 (1936)]. The energy of activation for flow is assumed to be $1/n$ of the energy of vaporisation, and it results that $n = 3$ for molecules with spherical symmetry and roughly 4 for non-spherical molecules. The activation energy for flow in liquid metals is a very small fraction of the energy of vaporisation, and it is thence deduced that the metal ions flow without their valence electrons. The structure of S at various temperatures is dealt with. The structure activation energy of flow in associated liquids due to the H_2 bond structure is discussed and the degree of co-ordination in liquid water is computed. The internal pressures of certain liquids are calculated with the aid of the viscosity under pressure, and the results agree with values calculated from compressibility data. P. H. B.

4378. Variations of Internal Friction of Solids under Thermal and Mechanical Treatment. R. Jacquesson. *Comptes Rendus*, 205. *pp.* 357–360, *Aug.* 9, 1937.—The variations at different temperatures of the damping coefficient and alternating deforming forces of torsion threads under strains above and below the elastic limit are considered in relation to intra-crystalline state. It is concluded that for the measurement of internal friction of a metallic thread, it must be submitted to a strain by the double-thread pendulum method. Measurements must be made as rapidly as possible and for small amplitudes. N. M. B.

See also Abstracts 4603, 4616, 4662.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

See Abstract 4393.

COMETS AND METEORS.

4379. Spectrum of Comet Peltier 1936a. P. Wellmann and N. Richter. *Zeits. f. Astrophysik*, **14.** 2. *pp.* 77–85, 1937.—A photographic study of the spectrum of this comet on Aug. 1, 1936, shows that its light is reflected sunlight, the C and CN bands having a relatively strong unidentified emission superimposed on them. Estimates of the relative proportions of gaseous and solid matter are deduced from the relative amounts of scattered and emitted light. G. C. McV.

4380. Cosmic Double Meteors. Dorrit Hoffleit. *Harvard Coll. Obs., Circ. No.* 420. [11 *pp.*], 1937.—Observations made in August 1934 and 1935 and Nov. 1935 of naked eye meteors occurring in pairs are inconclusive, but an analysis of telescopic observations of sporadic meteors indicates that 16% of 10th mag. meteors are members of binary systems, and since such close pairs will have suffered practically no disruptions within the age of the universe (taken as 3×10^9 yr.), this is also an estimate of the original proportion of 10th magnitude binary meteors, having separations of the order of 20 m. Assuming that 16% of all cosmic meteors formed binary systems 3×10^9 yr. ago, it is estimated that about 3% of the present naked eye sporadic meteors should represent real double meteors. A. S. D. M.

See also Abstract 4289.

COSMOGONY.

4381. Is the Universe Expanding? P. ten Bruggencate. *Naturwiss.* **25.** *pp.* 561–566, *Aug.* 27, 1937.—The author gives a summary of the observational material obtained by counts of extra-galactic nebulæ. He discusses the corrections which must be applied owing to the dispersion in absolute magnitude of the nebulæ and concludes that it is impossible to say for certain whether or not the red-shift is due to "velocity." G. C. McV.

4382. Evidence for a Stationary State of the Universe. W. Nernst. *Zeits. f. Physik*, **106.** 9–10. *pp.* 633–661, 1937.—The author suggests that the evidence drawn from the phenomena of cosmic rays, white dwarf stars, meteorites, transformation of chemical elements, etc. are all in favour of a stationary universe. G. C. McV.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

4383. Reduced Problem of Two Bodies of Variable Mass. G. Armellini. *Accad. Lincei, Atti*, **25.** *pp.* 297–301, *April* 4, 1937.—The reduced problem is defined as the special case which arises when the instantaneous eccentricity of the orbit always remains very small. In this case it is shown that the solution depends on a Riccati equation, the solution of which is developed for a particular law of variation of mass with time: $m(t) = (a + bt)^n$, a and b constants. W. S. S.

4384. Periodic Solutions of Restricted Three-Body Problem. Nathalie Rein. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 15. 8. *pp.* 433–436, 1937. *In French.*—The author draws attention to the 35-years' neglect of Whittaker's integral equations concerning the restricted problem of three bodies. An error in the expressions formulated by Whittaker is removed, and it is pointed out that as they stand they are valid only for periodic orbits of direct synodic motion. The corrected formulæ are extended to cover the case of inverse synodic motion. A supplementary relation is derived concerning a case not examined by Whittaker, and the complete theorem is re-stated. A. Hu.

4385. Three-Body Problem. N. Moïseiev. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 15. 9. *pp.* 539–542, 1937. *In French.*—A proof of the existence of certain simple, regular and periodic trajectories round the libration point L_1 is given. The motion in the trajectories is retrograde compared with the synodic motion. G. C. McV.

LATITUDE AND LONGITUDE.

4386. Latitude Variations at Greenwich. S. Kawasaki. *Kyoto Coll. Sci., Mem.* 20. *pp.* 87–137, *May*, 1937.—The minor variations in latitude observed with the Cookson floating zenith telescope at Greenwich are discussed. The Kimura term was found to have a secondary maximum and minimum both for the period 1911–18 and for 1919–27. The phase of the annual variation varies from year to year but that of the semi-annual variation is nearly constant. The Chandler period and variation were also found. A correctional term, kx, was found in the latitude variation, having a range of about 0·″015, but the phase is opposite to the Kimura term and by drawing the smoothed curve correctly the secondary maximum and minimum are shown. The diurnal variation of latitude was given by $s \cdot \sin(\Theta - a)$ where $s = 0 \cdot {''}018$ and it causes an annual variation of range 0·″02. The lunar semi-diurnal tide obtained from these observations was $0 \cdot 0108 \cos (2t - 9° \cdot 3)$ and agreed with theory. A correlation was found for the wind direction and the wind speed with the mean residuals of the plate for the period 1919–27 and the seasonal variation of wind produces an annual term in the observed latitudes. R. S. R.

NEBULÆ.

4387. Hagen's Dark Clouds. W. Becker. *Zeits. f. Astrophysik*, 14. 2. *pp.* 86–90, 1937.—Reasons for and against the galactic nature of Hagen's dark clouds are put forward. G. C. McV.

4388. Trapezium Cluster of the Orion Nebula. W. Baade and R. Minkowski. *Mt. Wilson Observat., Contrib. No.* 571. *Astrophys. J.* 86. *pp.* 119–122, *Sept.*, 1937.—Infra-red photographs of the central part of the Orion nebula show that the Trapezium stars are surrounded by a cluster of faint stars. The interpretation of this cluster presents curious difficulties. The assumption that the opacity of the nebula is considerably reduced in the vicinity of the exciting stars seems at present to offer the most likely explanation. Trumpler's observations of the Trapezium cluster are discussed. AUTHORS.

4389. Spectrophotometric Investigations of O- and B-Type Stars Connected with the Orion Nebula. W. Baade and R. Minkowski. *Mt. Wilson Observat., Contrib. No.* 572. *Astrophys. J.* 86. *pp.* 123–135, *Sept.*, 1937.—Photometric and spectrophotometric measures of a number of early-type stars connected with the Orion nebula are given for the wave-lengths between 4000 and 9000 Å. The results show that most of the stars are affected by strong selective absorption which increases rapidly from 9000 to 6000 Å to a nearly constant value for the shorter wave-lengths between 6000 and 4000 Å. If it be assumed that the absorption is due to dust particles, a preliminary discussion based on available theoretical data indicates that the diameters of the particles are of the order of 150 $m\mu$. The present limitations of such an analysis are discussed. AUTHORS.

4390. Survey of 36,000 Southern Galaxies. H. Shapley. *Nat. Acad. Sci. Proc.* 23. *pp.* 449–453, *Aug.*, 1937.—These are within the South Polar cap to − 60°; apparent Pg magnitudes and only approximate positions are obtained. There are 343 objects brighter than 15th mag. Two figures are given: (1) of the density of galaxies over the polar cap up to 17·5 mag., which correspond on the average to 115 million l. yrs. distance. Six nearly contiguous plates lying from − 80° to the edge of the polar cap have very high density and form (probably) a higher system containing 40,000 or 50,000 galaxies. There is only one other rich plate in the polar cap, a significant cluster at 276° − 31°, distant about 130 million l. yrs. Low galactic latitudes have small density due to galactic light absorption, but the galactic window near 301° − 16° has high frequency; (2) the second figure shows the relation of galactic number to apparent magnitude. A. S. D. M.

See also Abstracts 4381, 4408.

PLANETS.

4391. Physical Nature of Eros. F. Watson, Jr. *Harvard Coll. Obs. Circ. No.* 419. [14 *pp.*], 1937.—Eros shows irregular light variations at different oppositions. This is probably due to rotation, and the author seeks to determine the asteroid's equator, its orbital inclination and its form. Its maximum range is near a great circle in the sky (Pole. R. A., 21^h04^m, Dec. + 51°); its rotation is retrograde with inclination to the elliptic 152°·5, and to its orbit, 146°; its next maximum range is 1·5 mag. on Feb. 5, 1938. On Feb. 5, 1931, v. d. Bos and Finsen found its "figure-eight shaped," like a close double star, rotating clockwise, with its axis of rotation perpendicular to its greatest dimension. But it is argued that Eros must be "a long irregular solid mass," and not "a double asteroid" on the ground that asteroids are "fragments," and that during this "catastrophic" origin two fragments could not form such a system, nor could one fragment capture another [see Abstracts 517 (1934) and 4380 (1937)]. If it is a long solid, the length is about 35 km., the diameter 11 km.; if of density 3·5, its mass is $1{\cdot}2 \times 10^{19}$ grams. A. S. D. M.

4392. Motion of Asteroid Hilda (153). K. Hirayama and K. Akiyama. *Imp. Acad., Tokyo, Proc.* 13. *pp.* 191–195, *June*, 1937. *In English.*—The authors use the method of special perturbations and follow, numerically, the motion of Hilda from 1875 to 1956, considering the action of Jupiter and Saturn by integration intervals (40–160 days), according to the amount of perturbation; they adopt Kühnert's 1891 elements. A table of observations is given from 1875, Nov. to 1934 Feb., and corrected elements for epochs, 1925 Jan.–6·5, and 1938 July 1·5; from these it is found that the perihelion moved backwards about 10° during a period of 80 years, *i.e.*, in an opposite sense to the ordinary case but similar to the perisaturniem of Hyperion. Jupiter caused minor fluctuations at the nearest approaches of 1888 Oct., 1912 March, and 1935 Nov., and the asteroid, in consequence, librates with amplitude 40°, and period 415 years, having reached a maximum in 1925. A comparison is made between the elements of Hyperion-Titan and Hilda-Jupiter.

A. S. D. M.

STARS.

4393. Victoria System of Radial Velocity Determinations. W. E. Harper. *Dominion Astrophys. Obs. Victoria, Publ.* 6. 17. *pp.* 297–303, 1937.—The development of slight systematic errors has rendered it advisable to prepare a new definite list of lines suitable for radial velocity determinations for the various dispersions employed. The author reviews the main changes in the spectrographic equipment since 1918 and draws attention to the new value for the curvature correction adopted since Jan. 1, 1936; instead of the value − 1·0 originally found, the correction value became − 0·7. Tables are given for (1) Comparison lines, and for stellar lines used in classes (2) O and B, (3) A and F, (4) G-K-M single prism.

A. S. D. M.

4394. Spectrographic Orbits of Five Faint Variable Stars. R. F. Sanford. *Mt. Wilson Observat., Contrib. No.* 574. *Astrophys. J.* 86. *pp.* 153–161, *Sept.*, 1937.—Approximate spectrographic orbital elements of the four eclipsing variables TT Hydræ, SX Hydræ, WZ Ophiuchi, and UX Herculis, and of the β Lyræ variable TT Herculis are given. The mass functions for these binaries imply values of the component masses that range from one-half to three or four times the sun's mass. TT Hydræ and SX Hydræ have photometric orbits but do not show the secondary's spectrum. Since the other three do not have photometric orbits, no attempt has been made to combine spectrographic and photometric orbits. The evidence, from spectrograms in which a few double lines appear to be present, would indicate that the masses of the two components of WZ Ophiuchi are nearly equal and that, in the system of TT Herculis, m_2 is slightly less than one-half m_1.

AUTHOR.

4395. Magnesium Hydride in Arcturus and Antares. Dorothy N. Davis. *Astrophys. J.* 86. *pp.* 109–118, *Sept.*, 1937.—In the region from λ 4970·19 to λ 5210·90, 114 lines in the spectrum of Arcturus were previously unidentified. Forty-four of these lines may be attributed entirely to the λ 5211 band of MgH, while 62 of these and other Arcturus lines may be considered blends of MgH, TiO, C_2, and atomic lines. The more conspicuous features of the MgH spectrum appear less intense in the spectrum of Antares. Evidence for the presence of the λ 5621 (0, 1) and λ 4844 (1, 0) bands of MgH in Arcturus and Antares is not conclusive. Using eye-estimates of the intensities of 12 supposedly unblended lines in the Q_1 and Q_2 branches of the λ 5211 band of MgH, the effective rotational temperature is found to be 3600° ± 500° K. for Arcturus. The simultaneous occurrence of TiO and C_2 lines in these spectra is briefly described.

AUTHOR.

4396. Regional Study of the Interstellar Calcium Lines. R. F. Sanford. *Mt. Wilson Observat. Contrib. No.* 573. *Astrophys. J.* 86. *pp.* 136–152, *Sept.*, 1937.—The strength of the absorption of the interstellar K line is shown to increase with distance. The distance derived from apparent magnitude and spectral type appears to be affected by space absorption; and at the greater distances there may be a slight effect due to saturation which causes the absorption in the K line to increase less rapidly than at the smaller distances. The strength of the K line should serve as a fair measure of distance if allowance is made for the influence of galactic latitude and space absorption. No abnormal absorption is manifest in the direction toward the galactic centre. The K absorption shows a statistical increase with colour excess, although there is a considerable scatter for which irregularities in colour excess may well be responsible. This may be only a parallelism which does not certainly point to a common mechanism for the two phenomena. At the longitudes for the positive and negative maxima of differential galactic rotation the strength of K absorption correlates with residual velocity from the interstellar lines. For regions intermediate between null points and extremes for differential galactic rotation there is some correlation, although weaker, and at the null points none at all. With a few exceptions the residual velocities are less than one-half the K absorption. Galactic rotation cannot be the sole or even the dominating cause that defers saturation and permits the K line to grow in strength with distance. AUTHOR.

4397. Intensities of the Infra-Red CaII Triplet in Stellar Spectra. O. C. Wilson and P. W. Merrill. *Mt. Wilson Observat., Contrib. No.* 575. *Astrophys. J.* 86. *pp.* 162–165, *Sept.*, 1937.—The equivalent widths of the infra-red Ca II triplet, λλ8498, 8542, and 8662, have been measured on spectrograms of the sun and of several stars taken with a grating spectrograph having a dispersion of 33 Å/mm. The results for the solar lines agree well with those of other observers and are nearly proportional to the square roots of the theoretical multiplet intensities. In the stars, however, particularly the late-type giants, there is a strong tendency for the three lines to be more nearly equal in strength. The cause of the variation in gradient is not clear, and more extensive observations will be of interest. AUTHORS.

4398. Spectrographic Observation of the Reflection Effect in Close Binaries. O. Struve. *Astrophys. J.* 86. *pp.* 198–202, *Sept.*, 1937.—It is suggested that the narrow lines of the second component of α Virginis are produced by reflection of light of the first component in the atmosphere of the second. The observations seem to show a faint trace of the broad line arising from the normal light of the second component. AUTHOR.

4399. Degree of Variability of Calcium Content in Atmospheres of A-Type Stars. J. W. Abrams and E. Öpik. *Astrophys. J.* 86. *pp.* 203–211, *Sept.*, 1937.—A-type stars are classified spectrally by the ratio of the intensity of the K line of Ca to the mean intensity of Hγ and Hδ. A correction is made for interstellar Ca. The dispersion in colour is then determined for stars of the same spectral class. This dispersion can be accounted for by the dispersion in absolute magnitude, by the error in the K-line intensity, by the photometric error, and by a dispersion in the abundance of Ca. It is found, that excluding stars of markedly exceptional colour the first three effects account for the entire dispersion. This leads to the conclusion that the abundance of Ca is relatively uniform in stars of the same spectrum and absolute magnitude. AUTHORS.

4400. Theory of Rotating Polytropes. Z. Kopal. *Zeits. f. Astrophysik*, 14. 2. *pp.* 135–138, 1937.—It is shown that Chandrasekhar's equation for a rotating polytrope is soluble, when $n = 1$, in terms of Emden and Legendre functions. This solution enables the validity of Chandrasekhar's approximate methods to be determined. G. C. McV.

4401. Nuclear Processes and Energy Generation in the Interiors of Stars. R. Döpel and K. Döpel. *Zeits. f. Astrophysik*, 14. 2. *pp.* 139–154, 1937.—The energy generation which may be produced in stellar interiors by nuclear reactions in atoms not heavier than those of Li is discussed. The dependence of the reactions on temperature is determined and leads to the conclusion that there is either a very small region in which the reactions are effective or that there is a very large amount of H in the interior as compared with the stellar atmosphere. Some related questions are also discussed. G. C. McV.

4402. Orbits of Five Visual Binaries Belonging to the Hyades. G. P. Kuiper. *Astrophys. J.* 86. *pp.* 166–175, *Sept.*, 1937.—New orbits are derived for five of the six visual binaries for which orbits have been published before. The purpose is to obtain data on the masses of the Hyades as accurate as may now be obtained. These data are used in another paper for the determination of the hydrogen content of this cluster. [See following Abstract.] AUTHOR.

4403. Hydrogen Content of Clusters. G. P. Kuiper. *Astrophys. J.* 86. *pp.* 176–197, *Sept.*, 1937.—The hypothesis is proposed that the clusters are groups of stars of nearly the same H content. This hypothesis explains well-known properties of clusters. Trumpler's published observations of clusters are used, and in addition he has generously made available his unpublished data for three other clusters. The composite cluster diagram is identified with a set of lines of constant H content, although systematic deviations may occur for the very luminous stars, owing to the ageing of the clusters. The relative position of the clusters is adjusted with the aid of Mrs. Rieke's spectroscopic parallaxes. The result is that the lines of constant H content are crowded closely together on the lower part of the main sequence. A direct determination is made of the H content of the main-sequence binaries of the Hyades. The average value is 0·13, in contrast with 0·34 for ordinary main-sequence binaries. This determination is considered a proof of the correctness of the hypothesis: not only the giants, but also the main-sequence stars, of the Hyades contain little H. The small H content causes the Hyades to depart strongly from ordinary main-sequence stars in a mass-luminosity diagram, but unexpectedly they fall nearly on the same sequence as the other stars in the Hertzsprung-Russell diagram. A small displacement is present in the opposite sense expected from B. Strömgren's diagram. The result is in harmony with the composite cluster diagram and shows that, on the lower part of the main sequence, stars of entirely different composition may occur. [See preceding Abstract.] AUTHOR.

4404. Motions of Globular Clusters. H. Mineur. *Bull. Astronomique*, 10. 2. *pp.* 91–107, 1937.—Using the radial velocities now known for 26 globular clusters, it is shown that these clusters possess a retrograde motion around the galactic centre, on the average. This applies to clusters within 20,000 parsecs of the centre and within 10,000 parsecs of the galactic plane. The speed is 330 km./sec. in the neighbourhood of the sun and is a maximum at 15,000 parsecs from the galactic centre. G. C. McV.

4405. Apparent Diameters of Clusters. E. A. Kreiken. *Zeits. f. Astrophysik*. 14. 2. *pp.* 109–128, 1937. *In English.*—Theoretical evidence is given, that the observed fractions of the true diameters of clusters and nebulæ must systematically depend on: (*a*) the true surface brightness of the cluster (nebula), (*b*) the brightness of the stellar background, (*c*) the

amount of interstellar absorption, (*d*) the ratio between the apparent surface brightness of the cluster and that of the surrounding area at the point which is considered the limit of the cluster. The "observed" fractions were computed from theory. These theoretical fractions systematically depend on the distances of the various objects and on their galactic latitude. For the globular clusters and the spirals extensive observational data are available. Definite evidence is given that these observational data also are affected by the various systematical effects.
AUTHOR.

4406. Theoretical Light Curves of Eclipsing Variables of the β Lyræ Type. S. Takeda. *Kyoto Coll. Sci., Mem.* 20. *pp.* 47–86, *March*, 1937. *In English.*—Theoretical light curves are computed for a model eclipsing variable in which the components are tidally and rotationally distorted polytropes of index 3. The primary has a bright elongation towards the secondary. The loss of light due to the eclipse is calculated, numerical values of the integrals concerned being tabulated. The predicted curve is given in the form of equations. Corrections due to the distortion are divided into tidal and rotational terms, and allowance is made for a reflection effect. The results are compared with the observed light curve of β Lyræ. Whether or not darkening towards the limb is assumed, 2 sets of elements will reconcile theory with observation if one of the components can be taken to be much more distorted than the other. Reasons are advanced for believing that the larger star is the more deformed In this case the masses are comparable. The results suggest that some darkening towards the limb may exist, and that the reflection effect is insignificant.
A. Hu.

4407. Balance of Energy in the Development of Nova Herculis, 1934. W. Grotrian. *Zeits. f. Astrophysik*, 14. 2. *pp.* 129–134, 1937.—It is shown that about half the energy produced by the work of the gravitational forces during the outburst must be transformed into internal energy of the degenerate matter composing the core of the white dwarf into which the star develops. It is presumed that the other half of the energy is used up in breaking down atomic nuclei, heavy atoms being transformed into light ones during the outburst.
G. C. McV.

4408. Problem of Isophotometry. H. v. Hoff. *Zeits. f. Astrophysik*, 14. 2. *pp.* 104–108, 1937.—Isophotometric curves of such objects as gaseous nebulæ are obtained by the use of photographic prints on specially hard printing paper.
G. C. McV.

See also Abstracts 4388, 4389, 4427.

SUN.

4409. Chromospheric Preliminaries to Sunspot Formation. M. Waldmeier. *Zeits. f. Astrophysik*, 14. 2. *pp.* 91–103, 1937.—Unusually bright Hα-flocculi and spot-type protuberances joining two spots accompany the formation of groups of sunspots. The flow in a protuberance, it is suggested, takes place from the newer to the older spot. The central intensity of Hα is used for classifying flocculi.
G. C. McV.

See also **Abstracts 4733, 4743, 4744.**

GEOPHYSICS.

GEODESY.

4410. Geoid Determination. N. Mihal. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 16. 1. *pp.* 49–50, 1937. *In German.*—Starting from Stokes' formula for the distance (N) of the geoid from the ellipsoid level an expression is obtained $N = (R^2/4\pi\gamma)\int_0^{\pi}\int_0^{\pi}(d\Delta g/ds) H(\phi)d\phi d\lambda$, where R is the mean radius of the earth, Δg the gravity anomaly, ϕ the spherical distance of an element of surface from the point P along which N is calculated and γ the mean value of the earth's acceleration. The value $\partial\Delta g/\partial s$ can be obtained with an Eötvös variometer. A simplified expression is also given. R. S. R.

4411. Development in International Geodesy. J. de G. Hunter. *Nature,* 134. *p.* 75. *July* 10, 1937.—The proposals made at the Edinburgh conference of the Union of Geodesy and Geophysics to extend the scope of the areas covered by (1) triangulation, and so link up Europe, Asia, and North America and thence to Africa and Australia, and (2) gravity surveys, particularly over the oceans, are reviewed. In this way within a decade the shape and dimensions of the earth will be known much more accurately if the two kinds of results are combined. R. S. R.

GEOPHYSICS, APPLIED.

4412. Radio Waves Underground (Spark Geology). V. Fritsch. *Beitr. z. angew. Geophys.* 7. 1. *pp.* 53–67, 1937. *English Abstract.*—A number of measurements were carried out in the neighbourhood of the Kotterbach mines in Western Slovakia. The method applied, the so-called capacitance-method, has been fully explained in a previous paper [see Abstract 4091 (1936)]. This paper describes a suitable measuring equipment. Some sources of error and the means of avoiding them are pointed out. The influence of the weather upon the results is discussed and the modes of correcting it are indicated. Some designs of aerials based on the experiments are described. Finally, a number of new curves and C-lines are given. [See also Abstract 2000 (1937).] AUTHOR.

4413. Graphical Solutions in Torsion Balance Prospecting. V. G. Gabriel. *Beitr. z. angew. Geophys.* 7. 1. *pp.* 39–48, 1937. *In English.*—This article deals with an application of a graphical method to the evaluation of underground structures in torsion balance prospecting. First, a brief history of the method is given; then the influence of a body situated underground is computed mathematically and expressed diagrammatically through the use of the cylindrical coordinate system. Finally, the comparison between the analytical and graphical solutions are explained and evaluated. AUTHOR.

4414. Plutonic Phase in Seismic Prospecting. L. D. Leet. *Seismological Soc. of America, Bull.* 27. *pp.* 97–98, *April,* 1937.—Shots were fired at the bottom of a 46 ft. hole, and records taken in a well at depths of 2000–5790 ft. The seismograms (reproduced) show the phase *p*P clearly, *i.e.* waves of which the focal depth, and travel time to both epicentre and to a distant station are accurately known. C. A. S.

See also Abstracts 4416, 4440.

HYDROSPHERE, PHYSICS OF THE.

4415. Pressures and Velocities in Breaking Waves. P. Pétry and M. d'Ocagne. *Comptes Rendus,* 205. *pp.* 437–440, *Aug.* 30, 1937.—Arrangements are described to determine the height, length and velocity of a wave in the open sea, and the height, horizontal and vertical velocities of the same wave as it breaks, and the pressure exerted thereby at 3 points in the same vertical plane on the head of a jetty at Dieppe sloping at the base 1 in 5 and vertical above. Waves 40–45 m. long, 1·5–2·5 high, travelling 5·5–6·0 m./sec. in the open sea produced on breaking waves 2–3·5 m. high, travelling 6·5–12 m./sec. horizontally and 23–77 m./sec. vertically, and giving rise to pressures up to 69 × 10^3 kg./m^2. C. A. S.

LAND, PHYSICS OF THE.

4416. Differentiation of Rocks by Geiger-Müller Counter. V. A. Špak. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 16. 2. *pp.* 109–112, 1937. *In French.*—A Geiger-Müller counter with one amplifying valve (the rest of the necessary apparatus being at the surface) is placed at the depth in the boring at which an observation is to be made, and the radioactivity of the rock at that point measured, each such observation taking 10 min. The measurements are plotted against depth. Experience shows that the radioactivity of different samples of a rock from the same formation vary but little. C. A. S.

*4417. **Integrating Micrometer for Geometrical Analysis of Rocks. A. T. J. Dollar.** *Min. Mag.* 24. *pp.* 577–594, *Sept.,* 1937.—The instrument, which is figured and described in detail, with method of operating, is a microscope stage-micrometer for the quantitative estimation of one to six different constituents. It is suitable for linear micrometric analysis in petrography, etc., or for the volumetric evaluation of the components of building stone, road-metal, etc. Its chief difference from other petrographic micrometers is that while it utilises the "travelling nut" method only one micrometer screw is employed and the whole instrument can be rotated through 360° on the rotating stage of almost any modern petrographic microscope. C. A. S.

4418. Thermal Diffusivity of a Disperse Solid. A. Courtener and A. Chudnovskij. *Techn. Phys., U.S.S.R.* 4. 5. *pp.* 377–379, 1937. *In French.*—A method was recently described for the measurement of variations in the thermal diffusivity of the ground *in situ* [see Abstract 3965 (1937)]. The present paper gives constructional details of the linear isothermal heat source which forms the principal element used in this connection. R. W. P.

See also Abstract 4412.

METEOROLOGY.

*4419. **Climatological Emanation Measurements. H. Israël-Köhler.** *Gerlands Beitr. z. Geophys.* 51. 1. *pp.* 35–49, 1937.—The author's emanometer [see Abstract 4937 (1934)] is described with the method of working. The great advantage is avoidance of the lengthy enrichment process and consequent greater rapidity with which measurements can be made. The limits of accuracy are discussed and a table given of the saturation-corrections. C. A. S.

4420. Variations of Temperature at Oxford, 1815-1934. Lilian F. Lewis. *Meteorolog. Office, Prof. Notes, No.* 77. [12 *pp.*], 1937.

4421. Weather Forecasting. I. Krick. *Mechanical Engineering,* 59. *pp.* 579–582, *Aug.*, 1937.—Describes briefly the Norwegian method of air mass analysis, with surfaces of discontinuity, the changes taking place in these with time, and their motion. The methods used to obtain details regarding the vertical and horizontal distribution of the air masses are mentioned as also the applications of the analysis to weather forecasting for short or long periods. R. S. R.

4422. Increase of Wind Velocity with Height. J. Gilbert. *Comptes Rendus,* 205. *pp.* 371–373, *Aug.* 9, 1937.—Theory indicates that near the surface the average velocity of the wind, v, increases logarithmically with height (z), $v = a + b \log z$ (a and b constants). The weight of hoar frost, dP, deposited on an element dz, of a vertical rod is directly proportional to v, $dP = Kv dz$. Eliminating v between the two equations and integrating, the relation $P/z = \alpha + \beta \log z$ is obtained, which has been verified by measuring the amount of hoar frost deposited at various heights on a vertical rod. C. A. S.

4423. Formation of Hail. H. Frey. *Gerlands Beitr. z. Geophys.* 50. 2–4. *pp.* 216–222, 1937. *Julius Maurer Festschrift.*—Observations of hailstones at Kusnacht and elsewhere led to an analysis of the conditions favourable to the formation of hail and the internal structure of the cloud from which the hail is falling. For the production of hail a labile air layer, supersaturated with water vapour and with strongly supercooled water drops, at about 4000 m. is assumed. By the falling in of snow flakes tiny drops are first formed and with the large emission of latent heat at crystallisation they are shot upwards and then get a coating of ice. The frequent layers of ice in the hailstone are explained by the high level of the cumulus clouds. A premature disturbance of the labile equilibrium opposes the formation of hail. R. S. R.

4424. Turbidity Factor and Turbidity Diagram. A. Schneider. *Gerlands Beitr. z. Geophys.* 51. 1. *pp.* 69–99, 1937.—Feussner and Dubois [see Abstract 61 (1931)] state that the turbidity factor forms a basis for the construction of the turbidity diagram for all red, infra-red and short-wave radiation. The diagram plainly brings into use the change in the individual spectral regions. It has been applied to selected material and the results confirm those of Feussner and Dubois in reference to the unreal changes of turbidity factor with increasing solar altitude. The cause of this virtual change is examined and a method shown for its elimination. This leads to a new definition of the turbidity factor and an improved diagram, for red radiation. In conclusion, new turbidity factor constants are calculated and the Potsdam normal filter RG2 is introduced as a filter for red radiation. R. S. R.

4425. Evaporation from Free Water Surfaces. F. G. Millar. *Canad. Meteorolog. Mem.* 1. 2. [65 *pp.*], 1937.—Some wind tunnel experiments on evaporation are described, and these and other recent experiments are first discussed from an empirical point of view. Then the theory of turbulent mass exchange is used to develop equations for evaporation from both finite and infinite free water surfaces. The formulæ obtained are in agreement with the principle of dynamic similarity, are claimed to be of more general application than the usual power laws, and are verified by the observational material for a wide range in the size of surface. AUTHOR.

4426. Geometrical Theory of Haloes. Part IV. E. W. Woolard. *Monthly Weather Rev.* 65. *pp.* 190–192, *May*, 1937.—Continuing previous work [see Abstract 3488 (1937)] the author now calculates the positions of the images of the light source, sun or moon, on the celestial sphere. The images considered are those produced by prismatic refraction without internal reflection. Three cases are dealt with according as the refracting edge is (1) vertical (2) horizontal, (3) in any position. Formulæ and diagrams are given in each case to enable the calculations to be made. A. E. M. G.

4427. Colour Index of the Night Sky. Jessie Rudnick. *Astrophys. J.* 86. *pp.* 212–214, *Sept.*, 1937.—The average colour index of the night sky is found to be + 0·65 mag., about that of the sun, but it varies from + 0·35 to + 1·0 mag. As the colour index increases, the intensity of the light of the night sky in the red region increases and the intensity in the blue region decreases. AUTHOR.

***4428. Spherical Precipitation Gauge. O. Lütschg.** *Gerlands Beitr. z. Geophys.* 50. 2–4. *pp.* 423–444, 1937. *Julius Maurer Festschrift.*—Rainfall, flow-off and evaporation in the Alps are discussed, as well as the effects from place to place of wind on precipitation, particularly in the case of snow, and the means to ensure its collection. The construction of the special instrument is described, this having a series of openings through which the rain or snow passes. A series of tests have been made to compare its action at a number of places with the older standard pattern. The tests over the Montreux region north of Lake Geneva are fully described and a profile diagram of precipitation is shown for the Verraux range of mountains. The instrument is specially useful for snow, which is melted by electrical heating after falling into the instrument. R. S. R.

***4429. Photoelectric Colour Measurements in Meteorology. L. W. Pollak and W. Palme.** *Gerlands Beitr. z. Geophys.* 51. 1. *pp.* 56–68, 1937.—Describes a photoelectric colorimeter specially designed for determining the colour of the sky. The instrument employs three colour filters and a Lange photovoltaic cell. Some results obtained with the apparatus are given, and in particular the points on the colour triangle, which correspond to the various points on the Ostwald-Linke scale of blue, have been determined. The papers contain a full Bibliography of the subject. J. W. T. W.

***4430. Davos Frigorimeter and Climatic Amount of Cooling. H. Lettau.** *Zeits. f. Instrumentenk.* 57. *pp.* 333–336, *Aug.*, 1937.—The climatic amount of cooling is defined as (heat lost)/cm^2. sec. from the surface of a body with a mean temperature of 37° C. under the influence of weather elements (wind, temperature, radiation and precipitation). In the frigorometer described an electric current is used to keep the temperature of the surface constant. A full description of the apparatus and its method of working are given. R. S. R.

***4431. Transmission of Radiant Energy Through the Atmosphere. H. V. Hayes.** *Rev. Sci. Instruments*, 8. *pp.* 342–345, *Sept.*, 1937.—This paper reports progress in the development of apparatus for the transmission of signals in times of obscured vision. Descriptions of the results of tests made almost daily from Nov. 12, 1936 to May 20, 1937, in the transmission of signals over distances of about 480 m. and about 2400 m. using the Hayes radiometer as the receivers and sources of radiant energy of varied power and nature are given. There was not a day in the period covered where good signals were not received from a 25-W source over the shorter range nor any day when good signals were not received over the longer range when a source actuated by an input of about 650 W was used. There were but two days when the 25-W source failed to transmit clear signals over the longer range of about 2400 m. On these days the air was filled with heavy wet snow. AUTHOR.

See also Abstracts 4461, 4573, 4743, 4744.

SEISMOLOGY.

4432. Waves Following P_n at 30°–80° from Epicentre. E. Oddone. *Union Géodésique et Géophysique Internationale, Travaux Scientifiques, No.* 15. *pp.* 71–86, 1937. *Paper read at the Edinburgh Conference, Sept.,* 1936.—Possible explanations of the retardation exhibited by the waves that follow P_n, as compared therewith [see Abstract 655 (1935)] are discussed, (a) on the theory that this is due to reflection and/or refraction at various layers of discontinuity with some suggestions as to where these are, and (b) on the theory [see Abstract 2330 (1932)] that they may be due to the time occupied in the movement of magma or the accompanying gases, the commencement of which caused the first shock. C. A. S.

4433. Long Wave Oscillating in Principal Plane. P. Caloi. *Union Géodésique et Géophysique Internationale, Travaux Scientifiques, No.* 15. *pp.* 93–106, 1937. *Paper read at the Edinburgh Conference, Sept.,* 1936.—A new wave of long period (50 sec.) and velocity 6·2 km./sec., probably superficial, denominated C, is described; it oscillates in the principal plane and is closely analogous to the groups of waves SL and SM. [See Abstract 1071 (1935).] C. A. S.

4434. Direction of Vibrations. E. Rothé. *Union Géodésique et Géophysique Internationale, Travaux Scientifiques, No.* 15. *pp.* 107–113, 1937. *Paper read at the Edinburgh Conference, Sept.,* 1936.—The results obtained and likely to be obtained by the method of reconstituting the motion of a point in an earthquake from sets of seismograms recording the movements thereof in 3 mutually perpendicular planes are discussed with special reference to (a) known phases necessarily resulting from the laws of elasticity; (b) hypothetical phases based on assumed discontinuities in the earth; and (c) long waves. [See Abstracts 1601 (1927) and 1139 (1932).] C. A. S.

4435. Differential Coefficients in Geiger's Method of Locating Epicentres. J. H. Hodgson. *Seismological Soc. of America, Bull.* 27. *pp.* 109–112, *April,* 1937.—Geiger's method of approximation by a ratio of increments is laborious and, in some critical cases, an extremely poor one. It is shown how the true value for the differential coefficients may be determined much more easily. W. A. R.

4436. Travel of Seismic Waves from the Baffin Bay Earthquake of Nov. 20, 1933. A. W. Lee. *Meteorolog. Office, Geophys. Mem. No.* 74. [21 *pp.*], 1937.—The apparent velocity of P-waves is uniform for epicentral distances from 25° to 40°, and again from 45° to 50°, the velocity changing by 17% from 40° to 45°. There are discrepancies between the observations of S and the tables of travel-times hitherto available. A new table for S at distances from 25° to 50° has been computed from the travel times for P on the assumption that Poisson's ratio is constant for the rocks traversed by the waves. The agreement between the observations and this table is satisfactory. W. A. R.

4437. Further Study of Near Earthquakes. H. Jeffreys. *Roy. Astron. Soc., M.N., Geophys. Supplement,* 4. *pp.* 196–225, *Sept.,* 1937.—The same earthquakes [see Abstract 2293 (1933)] and the Oppau explosion are further discussed on the basis of records at nine observatories. The results, with some deduced from earthquakes in California, Japan and New Zealand, imply that the crustal structure inferred from European near earthquakes is probably not general. They are in definite disagreement with the usual hypothesis of uniform layers separated by smooth horizontal interfaces. The chief differences in distribution of amplitudes are explicable on the hypothesis of diffuse refraction by irregular interfaces, while the dying out of near earthquake pulses is explained by scattering by structural irregularities within the layers; though the final conclusion is that the crust consists of approximately uniform layers separated by transitions through depths of not more than a few km. C. A. S.

4438. Further Corrections to P, S, and SKS Tables. H. Jeffreys. *Roy. Astron. Soc., M.N., Geophys. Supplement,* 4. *pp.* 225–250, *Sept.,* 1937.—These further corrections, in particular those due to ellipticity of the earth for S and SKS, are based on observations of some 30 earthquakes, each at a number of different stations. They are discussed in great detail and tables are given. [See Abstract 3496 (1937).] C. A. S.

4439. Revised Travel-Time Tables. J. B. Macelwane and C. G. Dahm. *Union Géodésique et Géophysique Internationale, Travaux Scientifiques, No.* 15. *pp.* 87–92, 1937. *Paper read at the Edinburgh Conference, Sept.,* 1936. *In English.*—The Dahm (Long Beach), Macelwane (Tango-Long Beach-Hawke Bay), Jeffreys-Bullen (average), and Angenheister (Tonga-Samoa) time-distance curves are compared with the Hodgson (Tango) curve, all being reduced to a common origin. It is concluded that the genuine differences in travel-times due to differences in terrestrial structure exceed those due to differences in method of determining the curves. C. A. S.

4440. Seismic Time-Curves and Depth Determination. I. Lehmann. *Roy. Astron. Soc., M.N., Geophys. Supplement,* 4. *pp.* 250–271, *Sept.,* 1937.—It has been shown that the slow gradual increase of velocity which is likely to occur in uniform sedimentary layers gives rise to straight time-curves such as are usually obtained in prospecting. When depth is determined from straight time-curves on the assumption that the velocity is constant within the layers, a good approximation to actual depths is obtained provided the increase of the velocity in the layers is small and the separate layers are not very deep. If the velocity increases strongly within a layer straight time-curves may again be obtained, but if such time-curves are interpreted on the assumption of constant velocity within separate layers, serious departures from true conditions will be involved. It may be possible to detect a strong gradual increase of velocity by means of amplitude observations, but depth determination remains uncertain. AUTHOR.

4441. Earthquake Statistics. Part II. E. Wanner. *Gerlands Beitr. z. Geophys.* 50. 2–4. *pp.* 223–228, 1937. *Julius Maurer Festschrift.* An empirical law for near earthquakes at Vienna can be expressed in the form $y = 122e^{-0.0448t}$. Expressing this as a probability law the frequency distribution takes the form $y = A \cdot \delta e^{-\delta t}$. From a table of earthquakes for 20 years this gives $y = 18{\cdot}7e^{-0.0327t}$. A comparison of calculated and observed values gives fair agreement for large, and poor agreement for short time intervals. Further results from the Oxford tables are quoted. The causes for these differences are discussed and possible applications of the method considered. [For Part I see Abstract 3029 (1937).]

R. S. R.

4442. Direction of Approach of Microseisms. J. A. Archer. *Roy. Astron. Soc., M.N., Geophys. Supplement,* 4. *pp.* 185–196, *Sept.,* 1937.—In similar fashion the records of Wiechart seismographs at Hamburg, Ivigtut (S.W. Greenland) and Copenhagen, and of a Galitzin at the last-named, were examined for five of the six occasions selected by Lee [see Abstract 1538 (1935)]. The records of six other occasions at these places and at Kew were also examined in the same way. The results indicate a predominance of movements from the north at Copenhagen and from the east at Ivigtut, which indicates the N.E. Atlantic as the place of origin of the microseisms. This is definitely opposed to Gutenberg's "serf" theory. C. A. S.

***4443. Sensitiveness and Characteristic Frequency of Seismic Measuring Instruments. O. Meisser.** *Phys. Zeits.* 38. *pp.* 668–671, *Sept.* 1, 1937.—The relations between the natural period of vibration, damping, and magnification are discussed, and the connection of these with sensitiveness, for 20 different seismometers. C. A. S.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

4444. Exploring the Stratosphere for New Electrical Effects. R. A. Millikan. *Frank. Inst., J.* 224. *pp.* 145–151, *Aug.,* 1937.—A review of knowledge since 1911 of the electrical constitution of the atom and the emission and absorption of radiation by nuclear electrons is first given. Next the origin, penetration and energy measurement of cosmic radiation is discussed and the effects of nuclear absorption and impulse radiation. Finally, the absorption of electrons and protons by nuclei of the higher atoms up to 2×10^{10} V and the ionisation produced during descent through the atmosphere is examined. R. S. R.

4445. Atmospheric Potential Gradient at Ottawa. D. C. Rose. *Canad. J. of Research,* 15. *Sect. A. pp.* 119–148, *Aug.,* 1937.—The atmospheric potential gradient was observed continuously at the National Research Laboratories at Ottawa for a year ending Dec. 1, 1935, and at a country station about 9 miles northwest of Ottawa, for four months ending Nov. 1, 1936. The country station was set up on a site as free as possible from man-made pollution of the atmosphere. The records were studied from two points of view, the diurnal variation and disturbances in the normal fine weather value of the potential gradient. The results indicate that the diurnal variation is similar to that of other similarly situated stations. The study of disturbances in the potential gradient shows that all disturbances can be correlated with local meteorological conditions. The disturbances were for the most part associated with the stormy conditions usual at the passage of a front. The effect of city pollution on potential gradient records is clearly shown. AUTHOR.

4446. Globular Lightning. T. Neugebauer. *Zeits. f. Physik,* 106. 7–8. *pp.* 474–484, 1937.—It is shown that with the help of quantum mechanical interchange forces one can explain the holding together of a gaseous sphere free from electrons and positive ions if the electronic density is sufficiently great, *i.e.* of the same order of magnitude as the number of molecules per unit volume of air. Such a strong ionisation can arise particularly at the end of a charging channel of linear lightning, which is not consistent with the experience that globular lightning arises from linear flashes. The difference between suspended and adjacent globular lightning, the relative harmlessness of the former compared with the latter, the steady dissipation, and the explosion of globular lightning can be indicated quite naturally with the theory developed. Lastly recombination in globular lightning and its energy are calculated. R. S. R.

4447. Progressive Lightning. Part III. D. J. Malan and H. Collens. *Roy. Soc., Proc.* 162*A*. *pp*. 175–203, *Sept*. 15, 1937.—This paper is a continuation of previous work [see Abstract 147 (1936)] and deals with the variations in luminosity and velocity in the return stroke. From the investigation the luminosity-time curve at any point in the channel is seen to exhibit a fine structure. The authors regard the channel therefore as the seat of a number of component return strokes called into being by the branches on the channel. The data for the investigation were obtained from 120 flashes. After examining in the first place the general nature of the return stroke the authors proceed to deal with the method of measurement of the components and to discuss their distribution in time and duration: also the relation of the components to their corresponding branches. A number of special cases, photographs of which are reproduced, are examined with the aid of line diagrams. The total number of components, duration of channel luminosity and intensity distribution as revealed by the photographs are discussed in turn. It is concluded that the only important variations in luminosity are those connected with the development of branches. Reasons are suggested for the increase of current causing this variation in luminosity. No evidence is found of oscillations in the channel. A. E. M. G.

4448. Electric Current Systems of Magnetic Storms. A. H. R. Goldie. *Terr. Mag*. 42. *pp*. 105–107, *June*, 1937.—Reference is made to comments by Chapman [see Abstract 1151 (1936)] on the magnitude, direction and height of the currents found for magnetic storms of outstanding magnitude. There is a difference in time and location of the maximum current for these storms and others on moderate-storm days. It is considered that the deformation of the current flow depends on the magnitude of the storm and the general northward current becomes, in or about auroral latitudes, a concentrated eastward or westward current. Also with increasing disturbance still more current is diverted westwards along auroral zones. The possible solution of the lines of current flow is discussed. R. S. R.

See also Abstract 4734.

RADIOACTIVITY.

4449. Recoil Atoms of Radioactive Bodies. L. Goldstein. *J. de Physique et le Radium,* 8. *pp.* 316–320, *July,* 1937.—The perturbation of the recoil atom caused by the emission of a particle during radioactive disintegration is examined mathematically. The perturbation has two aspects (1) the adiabatic effect due to the response of the extranuclear electrons to the change of nuclear charge, (2) the possibility of collision of the emitted particle with the extranuclear electrons. The relative importance of these is examined. F. C. C.

4450. Quantity of Thoron by Gas Current Method. R. Duchon. *J. de Physique et le Radium,* 8. *pp.* 285–293, *July,* 1937.—A method is developed by which the quantity of thoron in equilibrium with a given Th solution is determined by circulating a current of gas through the solution and eventually passing the gas through an ionisation chamber connected to an electroscope. A closed circulating system is found to be superior to one of open type. Various advantages of the method are discussed. F. C. C.

4451. Dual β-Decay of Potassium. C. F. v. Weizsäcker. *Phys. Zeits.* 38. *pp.* 623–624, *Aug.* 15, 1937.—It seems possible that the induced radioactivity of K is due to its rare isotope K^{40} which has two stable isobars $_{20}Ca^{40}$ and $_{18}A^{40}$. A confirmation of the assumption that K^{40} decays dualistically with two abnormally long periods is of considerable interest to nuclear physics. This long period of decay may then be regarded not as a special property of the transition $K^{40} \rightarrow Ca^{40}$ but as a property of the nucleus K^{40} itself. Further light is thrown on the problem by a consideration of the respective spins of the three nuclei involved. G. O. B.

4452. Discussion on β-Type of Nuclear Transmutations. C. D. Ellis, J. D. Cockcroft, R. Peierls, H. O. W. Richardson. *Roy. Soc., Proc.* 161*A. pp.* 447–460, *Aug.* 20, 1937.—C. D. Ellis gave an outline of the theory of the neutrino and critical discussion of the evidence on which it is based, with a summary of recent advances in the experimental knowledge. J. D. Cockcroft discussed experimental evidence about the upper limit of the β-spectrum. The upper end of the spectrum, rather than its average, represents the disintegration energy. It is, however, not accurately given by the extrapolation method of Uhlenbeck-Konopinski. R. Peierls summarised recent developments in the theory. H. O. W. Richardson described how recent experiments on the shape of the energy distribution show that there are more slow electrons than are required by the Konopinski-Uhlenbeck theory. A linear combination of this distribution with the one given by Fermi represents the whole distribution curve very well. R. P.

4453. β-Ray Spectra of Li^8 and B^{12}. D. S. Bayley and H. R. Crane. *Phys. Rev.* 52. *pp.* 604–609, *Sept.* 15, 1937.—Cloud chamber measurements have been made on the β-ray spectra of Li^8 and B^{12}. The use of strict criteria in the selection of tracks for measurement is thought to have reduced preference for tracks at one or the other end of the spectrum. Separate measurements near the upper limits give for both spectra upper limits by inspection of $12 \cdot 0 \pm 0 \cdot 6$ eMV. Evidence is presented that the protons emitted during the formation of Li^8 have nearly zero energy. It is thus possible to determine the energy available in the radioactive disintegration of Li^8 into an electron, neutrino and two α-particles. Comparisons are made between the experimental Li^8 spectrum and those predicted by using the K-U and Fermi theories in conjunction with the recently measured α-particle distributions. It is shown that the K-U theory demands a reaction energy 5 eMV greater than that which is available. An indication is given that the protons emitted during the formation of B^{12} have an energy of at least 1 eMV, while a proton energy of nearly zero is required if the K-U upper limit, 14·5 eMV, is correct. AUTHORS.

4454. Ionisation by γ-Rays and Cosmic Rays in Gases at High Pressure and High Collecting Fields. J. Clay. *Phys. Rev.* **52.** *pp.* **143–148,** *Aug.* **1, 1937.**—Experimental test and theoretical considerations show that for the γ-ray ionisation measurements at high pressures by Clay and van Tijn at collecting fields of 5000–400 V/cm. there was no volume recombination. These measurements cannot be affected by criticism of Bowen and Cox founded on experiments with collecting fields of 1009–1·5 V/cm. The theory advanced by the author that for all pressures the volume ionisation is proportional to the pressure and that the wall ionisation (produced by electrons ejected from the wall) is for high pressures independent of the pressure is verified by experiments in air and in argon for γ-rays and for cosmic rays. This result removes the doubt expressed by Bowen and Cox on this point. For obtaining the saturation values at high pressures the Jaffé theory provides the only reliable method in existence. AUTHOR.

4455. Pair Creation by γ-Rays in a Cloud Chamber. M. Miwa and S. Kozima. *Phys. Math. Soc. Japan, Proc.* **19.** *pp.* **757–765,** *Aug.*, **1937.** *In English.*—The production of positive and negative electron pairs in a lead target by γ-rays of $\text{Th C}''$ is studied by means of a cloud chamber placed in the magnetic field. The energies of both partners of the pairs are determined from the curvature of tracks, the total number of pairs being 151. Most pairs were found to have the total kinetic energy of about $1\cdot51 \pm 0\cdot02$ eMV. By making necessary corrections the value is shown to be very close to the theoretical one $2\cdot62 - 2m_0c^2 = 1\cdot60$ eMV. The partition of energy between the individual partners of pairs is also studied and is found to show an asymmetry, the average energy of positrons being considerably higher than that of electrons. The energy of single positrons is also considered. The observed results are in general agreement with the theory presented by Jaeger and Hulme [see Abstract 602 (1936)]. AUTHORS.

4456. Compton Effect with γ-Rays. R. S. Shankland. *Phys. Rev.* **52.** *pp.* **414–418,** *Sept.* **1, 1937.**—This paper summarises the results of recent studies of the Compton effect using Geiger-Müller counters. The results show that no time lag as great as 10^{-4} sec. can exist in the Compton scattering process and that the angular relationship given by the photon theory is verified to within ± 20°. AUTHOR.

See also Abstracts **4251, 4257, 4416, 4419, 4551, 4578, 4646, 4647, 4648, 4724.**

RADIATION.

ABSORPTION AND TRANSMISSION.

4457. Optical Constants of Thin Gold Films on Quartz. F. Goos. *Zeits. f. Physik*, 106. 9–10. *pp.* 606–619, 1937.—Gold layers were deposited on quartz by kathode sputtering. The layers varied in thickness from 1 to 108 $m\mu$ and the transmissibilities and reflective powers at eight different wave-lengths in the infra-red, visible, and ultra-violet were measured for the different thicknesses. From these data optical constants have been derived. The variation of the optical constants as a function of layer thickness at different wave-lengths is discussed. [See Abstract 2669 (1936).] W. R. A.

4458. Light Absorption of Metallic Films at Low Temperature. T. Fukuroi. *Inst. Phys. & Chem. Research, Tokyo, Sci. Papers, No.* 720. *pp.* 172–186, *Aug.*, 1937. *In English.*—The intensity of light both transmitted and reflected at Hg, Cd or Zn films deposited on a cold surface of quartz is examined by means of a monochromator and photo-cell method. The change of the coefficient of light absorption with the change of film thickness is compared for the case of Hg with the result of calculation carried out by applying Mie's theory; the assumption involved in the theory under consideration is such that the metal deposit is composed of colloidal particles and the light absorption results from two conditions, conservative and consumptive dampings. Some further experimental evidence is given in favour of the above assumption on the structures and the colour-phenomena of a metal deposit. AUTHOR.

4459. Reflection and Absorption of Light by Partially Transparent Films of Silver and Aluminium. A. Baxter. *Journ. Sci. Instruments*, 14. *pp.* 303–306, *Sept.*, 1937.—The reflection and absorption coefficients of partially transparent films of Al and Ag are measured for normal incidence, the films being prepared by evaporation *in vacuo*. While Al is stable and fairly grey at all densities, Ag films show marked colour selectivity which varies both with density and age. From the results the two metals may be compared at any specified density and colour of light, for half-silvering Al always gives the higher reflection coefficient. The reflection coefficients of opaque films are also measured. AUTHOR.

4460. Theory of Colour of Organic Compounds. A. L. Sklar. *J. Chem. Phys.* 5. *pp.* 669–681, *Sept.*, 1937.—Several structural formulæ can be written for a coloured compound, since the molecule usually contains an alternation of single and double bonds. The colour is attributed to absorption bands corresponding to transitions between the levels which arise from a resonance among these different possible structures. A calculation is made for the levels of benzene, cyclohexadiene, fulvene and azulene; fulvene being a yellow compound, azulene a blue one; the others, although colourless, have absorption bands in the near ultra-violet. One parameter only enters the calculation and is evaluated by data on heats of hydrogenation. The absorption bands of the molecules are then calculated without using any optical data, the results agreeing well with experiment. The calculation is amplified in the case of benzene so as to include polar structures and also triplet states in the linear combination representing the molecule. The symmetry of the states is discussed in connection with selection rules, which are found to be in agreement with the relative intensity of the band groups in benzene. An interpretation of the structure of the 2600 Å band is proposed which is shown to account for many properties of this band system. AUTHOR.

***4461. Photoelectric Smoke Penetrometer. A. S. G. Hill.** *Journ. Sci. Instruments*, 14. *pp.* 296–303, *Sept.*, 1937.—The requirements of a method for determining rapidly the efficiency of filters which are used for the removal of particulate matter from gases are briefly discussed. A photoelectric photometric method for estimating the efficiency of filtering devices in terms of the percentage penetration of a standard testing cloud of carbon particles at a given rate of flow is described. Details are given concerning the apparatus and the manner in which it is operated. AUTHOR.

See also Abstract 4431.

COLORIMETRY.

4462. Colour Science and Colour Measurement. H. Schober. *Phys. Zeits.* 38. *pp.* 514–555, *July* 15, 1937.—The author gives an extended review (*a*) of present knowledge of the laws on which colorimetry is based, (*b*) of the concepts and methods of colorimetry, (*c*) of investigations bearing on sensitivity to colour, colour anomalies, effects of contrast, etc., and (*d*) of present theories of colour. The Bibliography gives 358 references. W. S. S.

4463. Transformations of I.C.I. Colour Specifications. D. L. MacAdam. *J.O.S.A.* 27. *pp.* 294–299, *Aug.*, 1937.—Methods are developed for passing from the I.C.I. standard trichromatic system of colour specification to other trichromatic systems satisfying prescribed conditions with regard to the values of the luminosity coefficients and the shape and size of the spectrum locus. As an example, the transformation of the I.C.I. data to a modified form of Judd's " uniform chromaticity diagram " is worked out in detail. W. S. S.

***4464. Instrument for Controlling Decoloration of Glass. L. Demkina.** *Techn. Phys., U.S.S.R.* 4. 5. *pp.* 380–382, 1937. *In English.*—The instrument described is a combination of a photometer and a wedge colorimeter. The intensity match is made by moving a lamp while the wedges permit of adjustment of the colour of the field. F. S.

4465. Effect of Light on Pigments and Dyestuffs. S. Nakamura and H. Kanazawa. *Imp. Acad. Tokyo, Proc.* 13. *pp.* 204–207, *June*, 1937. *In English.*—Test objects comprising papers brushed over with the pigments, and silks treated with the dyes employed in old Japanese fine arts were subjected to direct sunlight over a period corresponding to a full exposure of more than 80 hr. The colour changes were followed by colorimetric measurements on the Ostwald system. The pigments (mostly mineral) were found to show very little change. The dyestuffs (mostly vegetable) were less stable as a rule but some such as indigo showed equal stability with the mineral pigments. Zimmermann coloured papers as used in physiological experiments were also tested and found to be very unstable. W. S. S.

See also Abstracts 4429, 4570.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

4466. Application of Verdet's Law to Solutions: Magnetic Rotatory Power of Ions. R. Cordonnier. *Comptes Rendus*, 205. *pp.* 313–315, *Aug.* 2, 1937.—Using solutions containing 1·486 mol./l. of salts of monoacids, and 0·763 mol./l. of those of diacids the specific, and hence the molecular, magnetic rotation (that of H_2O being unity) were determined for the chlorides, nitrates and sulphates of K, Na, NH_4, and H for λλ 6400, 5100 and 4358. Comparison of the differences between the rotations for pairs of compounds with the same kation and different anions shows these differences to be practically independent of the kation. Results calculated on the assumption that the effect of the H^+ ion on the rotation is nil show that this is a fair assumption. [See Abstract 3493 (1933).] C. A. S.

4467. Magneto-Optical Dispersion of Methyl Malonate, Isopropyl Propionate, Isopropyl Butyrate, Ethyl Isobutyrate, and Tertiary Butyl Alcohol. C. Joyce Marsden and E. J. Evans. *Phil. Mag.* **24.** *pp.* 377–395, *Sept.*, 1937.—Full data are tabulated and plotted for refractive indices *n*, measured visually at five temperatures, for the wave-length region 0·6678 – 0·4472 μ, and photographically at five temperatures in the visible and ultra-violet. Magneto-optical rotations were determined at temperatures corrected by use of the temperature coefficients of the refractive indices. Values of Verdet's constant δ as observed at various wave-lengths and as calculated from the magneto-optical dispersion equation are tabulated. Results are considered in relation to Larmor's theory of magnetic rotation and show that the magneto-optical dispersion $n\delta$ of each liquid can be explained by the presence of a single absorption band in the Schumann-Lyman region. Equations for $n\delta$ and n are given, and values of e/m are deduced from these with the data for each liquid. N. M. B.

4468. Temperature Dependence of the Kerr Electro-Optical Effect for CS_2 and Halowax Oil. A. A. Zuehlke and L. R. Ingersoll. *J.O.S.A.* **27.** *pp.* 314–317, *Sept.*, 1937.—Kerr determinations for CS_2 were made in a glass cell with chromium-plated brass plates between −110° C. and + 20° C. The measurements on halowax oil (approximately 80% α- and 20% β-chlor-naphthalene) were made in a pyrex cell with similar plates, between 20° C. and 150° C. Dielectric constant measurements were also made by a method due to Williams, consisting of determining the capacity change of a variable test condenser by a heterodyne beat method, when empty and when filled with the liquid under test. It is concluded that the Kerr dispersion of CS_2 is independent of temperature for rather wide temperature and wave-length ranges. The Langevin-Born theory is found not to represent well the temperature variation of the Kerr effect either for non-polar CS_2 at low temperatures or polar halowax at high ones. The dielectric constant/temperature curve for CS_2 shows an abrupt increase of slope at −92° C. R. L.

See also Abstract 4669.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

4469. Inhibition of Fluorescence. K. S. G. Doss. *Indian Acad. Sci., Proc.* **6A.** *pp.* 24–31, *July*, 1937.—The data obtained by Jette and West regarding inhibition of fluorescence have been examined with a view to get at the mechanism of the inhibition process. The results show that inhibitions by ions such as Cl′, Br′, I′, etc., can be interpreted on the basis of collisions of the second kind. The auto-inhibition of fluorescence, however, as shown by a critical examination of fluorometric data cannot be explained on the basis of collisions of the second kind; it is found necessary to postulate polymerisation of the fluorescent substance, in order to explain the self-inhibition of the ultra-violet fluorescence of quinine sulphate and aniline iodeosine solutions. AUTHOR.

4470. Stepwise Fluorescence in Mercury-Nitrogen Mixtures. L. A. Turner. *Phys. Rev.* 52. *pp.* 632–637, *Sept.* 15, 1937.—The experiments of Wood and of Gaviola show that when Hg vapour is illuminated by light from a Hg arc, and N_2 is added in increasing amounts, the concentration of atoms in the $^3P_2$ state passes through a minimum. No simple theory accounts for this result. An explanation involving excitation of atoms in the $^3P_1$ state by vibrating N_2 molecules is discussed. The results obtained when a filter of Br_2 vapour is used indicate a transfer of excited Hg atoms from one to another ^3D state upon collision with N_2. AUTHOR.

4471. Pressure Distortion of Phosphors. N. Riehl and H. Ortmann. *Ann. d. Physik,* 29. 6. *pp.* 556–568, *July,* 1937.—It is shown that contrary to previous statements, grinding of ZnS and SrS does not affect the specific gravity. It is considered that the effect of pressure on the phosphorescence has been so far greatly exaggerated in significance, being merely due to the effect of fine grinding on the transparency and having nothing to do with centre distortion. The decrease of phosphorescence with fine grinding can be completely accounted for by the destruction of centres on the surfaces of the crystals, *i.e.* there is no evidence that the centres have any less mechanical stability than the pure lattice. J. E.

4472. Constitution and Properties of Phosphorescent Zinc Sulphides and other Phosphors. N. Riehl. *Ann. d. Physik,* 29. 7. *pp.* 636–664, *Aug.,* 1937.—Very pure ZnS shows, besides its well-known fluorescence, also phosphorescence. In particular the blue band which is frequently observed, is also present in the pure substance and is therefore not to be attributed to contaminations. Its spectrum is identical with that of the fluorescent light emitted during the excitation. Its intensity is reduced if the substance is contaminated by other metals, such as Cu, which produce a different phosphorescence of their own. If such contaminated ZnS is subjected to rays of u.v. light the yield of luminescence is so high that the energy must have been at first absorbed by the Zn or S atoms, but since it is eventually emitted by the impurity centres, there must be a mechanism of transferring the energy over as much as 10 atomic distances without it being transformed into heat. A part of this energy is re-emitted immediately while some part remains and can only be emitted under the action of the thermal motion of the atoms. Hence the phosphorescent energy can be "frozen in" and released upon reheating the substance. Data are also obtained on the mobility of Cu atoms in the ZnS lattice and their probable positions in the lattice are discussed. The position is similar for other phosphorescent substances. R. P.

See also Abstracts 4306, 4376, 4480.

INTERFERENCE, DIFFRACTION AND SCATTERING.

4473. Distant Diffraction. J. Savornin. *J. de Physique et le Radium,* 8. *pp.* 309–312, *July,* 1937.—The results of experiments on the diffraction of light by the straight edges of metallic shields made of different metals show that the metal affects the character of the diffraction. The experiments are accounted for by electromagnetic theory when the latter is modified so as to take account of the optical properties of the metal concerned. [See Abstract 5519 (1936).] G. C. McV.

4474. Diffraction Pattern Due to an Absorbing Prism. R. C. Spencer. *J.O.S.A.* 27. *pp.* 318–322, *Sept.*, 1937.—An equation is derived for the case of Fraunhofer diffraction through an absorbing prism limited by an aperture. This reduces for the case of zero absorption to the usual equation, and for the case of an infinite absorbing prism, to a witch. Curves are plotted to show how the diffraction bands fade out with increased absorption. The theory is checked by photographs of light sent through a liquid prism of Indian ink solution. The chromatic resolving power of an infinite absorbing prism is derived. The equation is modified for the grazing angles used in X-rays and an angular half-width of the diffraction pattern of 2·37″ of arc is computed for the case of Bearden and Shaw's experiment on the refractive index of quartz at 1·54 Å. [See Abstract 5098 (1934).] AUTHOR.

4475. Optical Specification of Light-Scattering Materials. D. B. Judd, with W. N. Harrison, B. J. Sweo, E. F. Hickson, A. J. Eickhoff, Merle B. Shaw, and G. C. Paffenbarger. *Bureau of Standards, J. of Research,* 19. *pp.* 287–317, *Sept.*, 1937.—In 1931 Kubelka and Munk [see Abstract 1179 (1932)] worked out the relationship between reflectance and thickness of material for thin, homogeneous layers illuminated diffusely. In the equation expressing this relationship, the hypothetical ideal material is defined by two constants, reflectivity and coefficient of scatter. In the present paper are given data demonstrating how well several materials of commerce can be specified by these constants. These include data on vitreous enamel, dental silicate cement, cold-water paint, and paper. AUTHOR.

4476. Longitudinal Light Scattering. M. Katalinić. *Zeits. f. Physik,* 106. 7–8. *pp.* 439–452, 1937.—A method is described for the determination of the variation with direction of the intensity of the light scattered at a single particle in a monodisperse colloidal solution or a suspension. Experiments with water repeatedly distilled *in vacuo* failed to produce any scattering coronas such as were observed by Plotnikow; these reappeared when air was admitted to the apparatus, but disappeared when the water was allowed to stand. The effect is therefore attributed to scattering at suspended dust particles. Variations in the diameters of the coronas are discussed. C. B. A.

4477. Examination and Retouching of Quartz Plates Cut Perpendicular to the Optic Axis. R. Servant. *Rev. d'Optique,* 16. *pp.* 215–229, *June–July,* 1937.—In plane parallel plates of quartz cut perpendicular to the optic axis the perpendicularity of the faces to the axis is always realised only in an approximate way. For thin plates, where the problem is most important, a procedure is devised to measure the error in cutting and to improve the plate by retouching. Interference fringes formed by the plate are observed in convergent light between crossed nicols and their displacement as the plate is rotated is noted. It is based on a theory proved by consideration of refractive indices. Plates can be retouched by this method nearly to 1′. R. S. R.

★**4478. Machines for Ruling Diffraction Gratings. W. Stone.** *Journ. Sci. Instruments,* 14. *pp.* 309–311, *Sept.*, 1937.—The design of a type of machine is described which will reduce to a minimum the displacement of the lines being ruled, due to changes of temperature of the machine and of the plate on which the rulings are being made. Some suggestions

for improvements in the design and construction of machines for ruling diffraction gratings were made by the author in an earlier paper [see Abstract 622 (1937)]. Further improvements, particularly as regards expansion of the parts due to changes of temperature, are suggested.
AUTHOR.

See also Abstracts 4512, 4566, 4630, 4631.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

4479. Fundamentals of Photosynthesis. J. Franck. *Washington Acad. Sci., J.* 27. *pp.* 317–329, *Aug.* 15, 1937.—A general discussion is given of the photo-reduction of H_2CO_3 to H·CHO. A mechanism for the reaction is suggested which successfully explains a large number of observations, *e.g.*, the absence of an inductive period when leaves are irradiated by weak light: the phenomenon of light saturation, etc. H. G. C.

4480. Inner Recombination in the Photodissociation of Polyatomic Molecules. A. Terenin and R. Tshubarov. *Acta Physicochimica,* 7. 1. *pp.* 1–26, 1937. *In English.*—It is shown by direct experiment that a polyatomic molecule, like SnI_4, can be disrupted by absorption of light in such a way that a saturated molecule, in this instance I_2, is liberated. Thus, simultaneously with the process of photo-dissociation, a recombination of the liberated atoms before they leave the remainder of the molecule takes place. The method used consists in the investigation of the visible fluorescence of I_2 excited in SnI_4 vapour under the action of u.v. light. An additional thermal energy of activation is necessary for this process. The observed threshold of the photo-dissociation can be explained under the assumption that, simultaneously with disruption, the Sn atom passes from the quadrivalent to the bivalent state. The quenching of the fluorescence is studied. AUTHORS.

4481. Reduction Potential and Photographic Developers; Effect of Sulphite in Developer Solutions. R. M. Evans and W. T. Hanson, Jr. *Kodak Research Lab., Comm. No.* 601. *J. Phys. Chem.* 41. *pp.* 509–534, *April,* 1937.—Part I describes direct measurements of reduction potentials of amidol developers, using potassium ferrocyanide as "potential mediator"; potential data are given as functions of amidol and Na_2SO_3 concentration and of pH (4–11). The authors confirm for such developers the findings of Reinders and Beukers with developers of the ferrous oxalate type, *viz.* (*i*) that a predeveloped Ag image in Ag halide is completely and continuously reversible about a single "equivalence" potential, (*ii*) that a greater reduction potential is required to initiate development of the latent image than to continue the process. The "equivalence potential" becomes more negative in the presence of Na_2SO_3 and is further reduced by Br′, in accordance with the usual theory; for a given developer, it had the same value for two different emulsions. Part II is a theoretical survey showing that the postulate, that sulphite in a developer acts as an acceptor for the developer oxidation product, accounts for the protective and stain-preventive action of the sulphite and for its action in increasing the developable density. This postulated action is analogous to that of the coupler in Homolka's coupler-developers. L. V. C.

4482. Photographic Development and the Latent Image. R. M. Evans and W.T. Hanson, Jr. *Kodak Research Lab., Comm. No.* 615. *Phot. J.* 77. *pp.* 497–515, *Aug.,* 1937.—Briefly discusses a new theory of photographic development and the latent image, in which the latent

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image is assumed to consist of a concentration of internally photo-released electrons held at a sensitivity speck. Developers are described as reducing agents having reduction potentials within rather wide limits and characteristic adsorption isotherms for Ag-halide crystals. Development is assumed to be of two types, chemical, consisting of three simultaneous steps, or chemical-physical, in which Ag complexes are formed and immediately reduced by the developer to metallic Ag. Finally, the application of the theory in the explanation of known effects is briefly considered. R. C. F.

4483. Exhaustion of X-Ray Developer. J. M. Kenny, E. A. Harvey, D. P. Woosley and H. Baines. *Radiography*, 3. *pp.* 115–127, *Aug.*, 1937.—Describes an economical method of periodic regeneration, based on a quantitative examination of the changes in concentration of development constituents, which will indefinitely maintain constant development characteristics. Thus the necessity of altering exposure or development technique throughout the life of a developer bath is obviated. The points dealt with are determination of concentration of developer constituents during exhaustion, experiments on the periodic regeneration of the developer, application of regeneration to radiographic practice, giving details of the unit system, detailed instruction for using the unit system, describing two methods, hospital experience of regeneration by the unit system, and comparison of cost of regeneration method with normal development method. R. C. F.

4484. Synæresis Phenomena in Silver Iodide. Lüppo-Cramer. *Kolloid Zeits.* 80. *pp.* 72–76, *July*, 1937.—AgI prepared (in the absence of protective colloid) in the presence of a large excess of I' loses its light-sensitivity in a few days. This loss may be avoided by the addition of sugar or other inert crystalloid to the AgI; it is attributed to a process of synæresis or flocculation wherein the AgI-gel becomes more compact, a conclusion supported by the lower adsorption of basic dyes by the "aged" AgI. L. V. C.

4485. Properties of Emulsions. W. Meidinger. *Phys. Zeits.* 38. *pp.* 564–572, *Aug.* 1, 1937.—Gives the results of observations made on the dependence of the grain growth in photographic emulsions on the digestion time, on the KBr excess of the gelatin concentration, and on the I content. The emulsions used were specially selected so that the variations in grain size obtained were due solely to the time of digestion. Values of the number of grains per cm^2. of layer, average grain mass, diameter of grain projection, surface per gram of AgBr, and the ratio of surface to total Ag are given for the various emulsions. Details of the absorption and reflection for 4360 Å, and the effect of NO_3' concentration on solarisation are also given. R. C. F.

***4486. Apparatus for Accelerated Kinematography. O. Bronn and V. Alexandrov.** *Techn. Phys., U.S.S.R.* 4. 5. *pp.* 370–376, 1937. *In English.*—A simple and cheap apparatus for accelerated kinematography is described, capable of taking 24 successive photographs with exposures as small as 1/100,000 sec. It has been used for the study of the extinction of electric arcs, and stereoscopic photographs may also be obtained. A. H.

***4487. Source of Diffused Light. M. Roulleau.** *Soc. Franç. Phot. et Ciné, Bull.* 24. *pp.* 85–88, *May*, 1937.—Describes a source of diffused light which has been developed for certain types of sensitometers. The source must take the form of a disc, at least 10 cm. dia., with a brightness as high as possible, uniform, and with a colour temperature between 2,500 and 3,000° K. These conditions are satisfied by combining an opal glass plate, 0·2 mm. thick, and of low absorption, with 500 W opal lamp, of 15 cm. dia. Details regarding lines of equal brightness of the source, and the neutrality of the opal glass are briefly examined, it being shown in the latter case that the departure from neutrality is small if the angle of incidence differs only slightly from the normal. R. C. F.

***4488. Dynamical Basis of the Rotating-Disc Shutter. G. Maass.** *Phot. Indust.* 35. *pp.* 876–878, *Aug.* 18, 1937.—The " robot "-shutter consisting of a rotating disc with open sector of fixed angular size, the speed of rotation being varied, can be made to operate at an essentially uniform speed throughout its operation, thus avoiding the distortions and irregularities which arise with shutters of the " roller-blind " type having variable openings. The elementary dynamics of the system is given. L. V. C.

***4489. Simple Method of Stereoscopic Photomicrography. S. Shimadzu.** *Kyoto Coll. Sci., Mem.* 20. *pp.* 1–2, *Jan.*, 1937. *In English.*—A simple method of taking stereoscopic photomicrographs with an ordinary microscope is described. AUTHOR.

***4490. Low-Power Stereoscopic Photomicrography. C. W. Wilman.** *Phot. J.* 77. *pp.* 491–496, *Aug.*, 1937.—Discusses some of the problems arising in the production of low-power stereoscopic photomicrographs by direct photographic methods, and satisfactory apparatus is described. The sections briefly dealt with are minimum and maximum magnification, taking and viewing conditions, maximum depth of subject, permissible stop, and practical arrangements. R. C. F.

See also Abstracts 4465, 4548, 4550.

PHOTOMETRY.

4491. Concept of the Luminous Field and its Application to Photometry. A. A. Gersun. *R.G.E.* 42. *pp.* 5–12, *July* 3, 1937.—In a space traversed by light rays it is possible to define at each point a scalar magnitude—the space illumination—and a vector—the luminous vector. The former represents the average value of the illumination falling on an infinitesimal sphere with its centre at the given point, and the latter represents the difference in illumination of the two faces of a small plane element of area containing the point and so directed that the difference of illumination is maximal. The general laws which these magnitudes obey are derived. For example, the luminous vector E and the space illumination E_0 satisfy $\operatorname{div} E = -4kE_0$ in a medium with an absorption coefficient k. In general the luminous field is rotational, *i.e.*, $\operatorname{curl} E \neq 0$. The application of these two concepts to the determination of the light distribution in practical problems and, in particular, the use of graphical methods are discussed. W. S. S.

***4492. Brightness Meter. M. Luckiesh and F. K. Moss.** *J.O.S.A.* 27. *pp.* 292–293, *Aug.*, 1937.—Gives details of a more simple brightness meter than the one previously described [see Abstract 2068 (1937)] which not only measures relative brightness but also depends on any foot-candle meter to convert the relative brightnesses into absolute brightnesses. The meter consists of two tubes, one of which is a universal focus telescope sighted so that the object to be measured appears in the centre of the photometric field. The other contains a perfectly diffusing glass, which is seen in the mirrored portion of the field and provides the comparison brightness. A circular gradient of wide range in transmission factor is used to vary the brightness of the focused object and the relative brightness read from a scale on the instrument. The actual range is of the order of 2,000 to 1, and reducing and multiplying screens can be used to vary this range. R. C. F.

See also Abstract 4461.

POLARISATION.

4493. Optical Properties of Incandescent Metals. F. Schubert. *Ann. d. Physik*, 29. 6. *pp.* 473–496, *July*, 1937.—Measurements were made of the degree of polarisation of the light emitted at various angles with the normal to the surface by incandescent metal foils of Cu, Ni and Pt. For Pt the degree of polarisation of the light reflected by the surface was also determined, both at room-temperature and at temperatures about 800° C. The degree of polarisation in both cases depends on the optical constants of the metal and it was sought to determine the variation with temperature of these constants. Structural changes in the surface of the metal due to the heating and cooling processes also modify the degree of polarisation and serve to mask any true temperature effect. Photomicrographs are included showing some of these changes. A true temperature coefficient of the optical constants of the metals studied could not be established. W. S. S.

4494. Oblique Reflection of Light at a Mercury Film on Glass or Tin Leaf. T. Fukuroi. *Inst. Phys. and Chem. Research, Tokyo., Sci. Papers, No.* 719. *pp.* 157–171, *Aug.*, 1937. *In English.*—The effect of the change in the film-thickness, on the change in intensity as well as in polarisation of the partially polarised light reflected obliquely from the films of Hg condensed on cold surfaces of Sn leaf and glass, the angle between the incident and the reflected waves being 60° and 150°, is studied experimentally.

4495. Rotatory Dispersion in the Amine Series. Part I. T. M. Lowry and W. C. G. Baldwin. Parts II and III. W. C. G. Baldwin. *Roy. Soc., Proc.* 162*A*. *pp.* 204–232, *Sept.* 15, 1937.—Part I—Absorption spectra and rotatory dispersions are recorded for *spiro*heptane diamine, its hydrochloride and acetyl and benzoyl derivatives, and the rotatory dispersion of diamidocarbonamino*spiro*heptane is measured. The changes of rotatory power of amino-bases on neutralisation are caused by saturation of the lone-pair electrons of the N-atom, which can contribute largely to the optical activity. Amino-bases are divided into two classes according as the lone-pair absorption bands at 2300 Å are active or inactive. When they are inactive, neutralisation causes little change. The *spiro*heptane base falls into the latter class. Theoretical values of rotatory power for these compounds deduced from Born's formula are of the correct order except when long side chains are present. Part II—*l*-Secondary-butylamine falls in the first class. Dissymmetry in the spirane nucleus is apparently insufficient to cause activation of the lone-pair. The anomalous dispersion of the base is satisfactorily explained and its absolute configuration is defined. The results are correlated with those for nicotine and derivatives. Part III—Absorption spectra are recorded for aqueous solutions of hydrazine and ethylene diamine and their mono- and di-hydrochlorides. The suppression of absorption which accompanies the progressive saturation of the nitrogen lone-pair electrons is discussed. C. B. A.

4496. Phase-Difference Measurements. G. Szivessy and W. Herzog. *Zeits. f. Instrumentenk.* 57. *pp.* 305–332, *Aug.*, 1937.—The methods employed in earlier types of instrument are described. For wider ranges different methods are necessary but the results are valid only for a doubly refracting layer, and the methods cannot be used to measure the azimuth and ellipticity of an elliptically polarised ray. Two instruments are dealt with, the Brace compensator and the authors' half-shadow compensator. For each are given the differences from the old method, the determination of the phase difference, the most favourable setting of the polariser, the sensitivity, the azimuth of the analyser, and the measuring procedure. R. S. R.

See also Abstracts 4477, 4565, 4630.

RADIATION, EMISSION.

4497. Cosmic Radiation. P. M. S. Blackett. *Roy. Soc. Arts, J.* 85. *pp.* 893–903, *Aug.* 13; 905–918, *Aug.* 20, *and pp.* 921–931, *Aug.* 27, 1937.—The first paper describes the results which have been obtained using ionisation chambers to detect the radiation. These concern the variation of the intensity of the radiation with height above and depth below the earth's surface; the variation with latitude, chiefly at sea level, but to some extent at various heights; and the variation with time, which is discussed in its relation to the question of the origin of the rays. The second paper describes directional measurements carried out with Geiger-Müller counters. The effect of the earth's magnetic field on the orbits of charged particles of high energy is dealt with, and the conclusions applied to the latitude variation of cosmic-ray intensity. In the third paper the counter-controlled cloud-chamber is discussed. The theory of the formation of cloud-tracks is outlined, and applied to determine the mechanical conditions, as regards the acceleration of the piston, if satisfactorily narrow tracks are to be obtained. Some preliminary energy spectrum results obtained by the author are given, and some shower-tracks are illustrated and discussed. D. H. F.

4498. Counter Experiments on the Mechanism of Shower Production. Y. Watase. *Phys. Math. Soc. Japan, Proc.* 19. *pp.* 749–756, *Aug.*, 1937. *In English.*—With use of the triple, quadruple and quintuple coincidence methods the initial trends of the Rossi transition curves are investigated. The shower productions by the single elementary process as well as by the successive multiple processes are confirmed, and the difference in the nature of the shower radiations in these cases is discussed. Supplementary investigations using different counter arrangements or different elements as shower-producing material have also been undertaken. [See also Abstract 4158 (1936).] AUTHOR.

4499. Electrodynamic Force Equation and Existence of New Cosmic-Ray Particle. W. F. G. Swann. *Phys. Rev.* 52. *pp.* 387–390, *Sept.* 1, 1937.—It is shown that the force in the force equation of electrodynamics may be multiplied by a relativistic invariant which leaves the equation practically unaltered for low velocities but which becomes important as the velocity of light is approached. The application of the invariant does not affect the constancy of the ordinarily assumed relativistic kinetic energy for motion in a pure magnetic field. The presence of the invariant referred to would result in an erroneous value for the momentum if the results of experiments were interpreted by the ordinary force equation. Moreover, the momentum which such an erroneous calculation would yield would depend, in the example cited, upon the magnetic field in which the measurements were made. Certain tentative remarks are made concerning the relationship of these matters to the evidence for the existence of the neutrino. AUTHOR.

4500. Shower Production under Thick Layers of Various Materials. K. Z. Morgan and W. M. Nielsen. *Phys. Rev.* 52. *pp.* 564–567, *Sept.* 15, 1937.—Observations by Geiger-Müller counters are reported on showers from lead and iron up to thicknesses of approximately 600 gm./cm^2. As previously noted by others, the transition curves at large thicknesses have approximately the same slope as absorption curves obtained for the general cosmic radiation. Data are presented for the iron-lead and lead-iron transition curves beginning at a material thickness of 274 gm./cm^2. in each case. For the iron-lead transition curve, the number of coincidences increases and attains a maximum in approximately 1 cm. of lead, after which the counting rate decreases and finally falls on the air-lead transition curve. For the lead-iron transition curve, the number of coincidences decreases for the first increments of added iron, passes through a minimum and then increases to the air-iron transition curve. It is pointed out that the observations are consistent, in a qualitative way, with the multiplicative theory of the origin of cosmic-ray showers provided one assumes that additional shower producing radiation is generated in the lower layers of material. AUTHORS.

4501. Shower Production in Various Materials. W. M. Nielsen and J. E. Morgan. *Phys. Rev.* 52. *pp.* 568–569, *Sept.* 15, 1937.—Data are presented on the increased counting rate due to shower production by layers of equal atomic density for copper, tin and lead. The observed increases of counting rate in the case of these elements are found to vary as a power of the atomic number which is slightly although significantly greater than the second. These results appear qualitatively consistent with our previously reported observations in which the mass per unit area of the producing materials was kept constant for the various elements and for which a dependence on the atomic number of the second power was reported. AUTHORS.

See also Abstracts 4431, 4444, 4454, 4487, 4567.

RADIATION, GENERAL THEORY.

4502. Bose Statistics and the Radiation Theory of Dirac and Fermi. B. Ferretti. *N. Cimento,* 14. *pp.* 228–235, *May,* 1937.—A calculation is given from which it appears to follow that the fundamental assumptions of Bose-Einstein statistics are incompatible with the quantum theory of radiation in Dirac's form. R. P.

4503. Photon as a Dipole. J. Malfitano. *Comptes Rendus,* 205. *pp.* 220–222, *July* 19, 1937.

4504. Photon Theory. L. de Broglie. *Comptes Rendus,* 205. *pp.* 345–349, *Aug.* 9, 1937.—The author further develops his theory of the photon which eliminates the absolute zero of energy. He shows that the quantisation of the field variables derives directly from the "superquantising" of the wave-function with 16 components of the photon. A method for writing down the exact commutation relations for fields in empty space is also given. G. C. McV.

4505. Electronic Charge and Materialisation of the Photon. S. A. de Mayolo. *Comptes Rendus,* 205. *pp.* 360–362, *Aug.* 9, 1937.—The author summarises expressions for and relations between the fundamental magnitudes on the basis of his electromagnetic field theory [see

Abstract 666 (1936)]. When a light ray passes through matter these magnitudes are valid for the material medium as a function of new parameters. It is deduced that at a critical velocity u_0 the charge $\pm Q$ of the photon will be equal to e, and on materialisation will correspond to an electron and a positron, that l, the radius of the photon in the medium, is e^2/m_0c^2, and that the fine structure constant $\alpha = u_0/c$. The velocity u_0 for which $\pm Q_0 = \pm e$ is that of the electron in the first Bohr orbit of the atom, and α is the factor of materialisation, the quotient of the maximum and minimum velocities of the photon. An analogy with the critical temperature of gases is pointed out. N. M. B.

4506. Gravitational Energy of the Photon. A. March. *Zeits. f. Physik*, 106. 5–6. *pp.* 291–295, 1937.—Application of the statistical metric gives a finite value for the gravitational energy of the photon, which for $\nu = 10^{15}$ sec.$^{-1}$ amounts to about 1% of $h\nu$. In the solution of this problem the constant γ, the classical electron radius, enters, although the problem has nothing to do with the electron. This fact is connected with the author's idea that γ is not specifically an electronic constant but a constant determining the metrical structure of the space-time continuum. W. S. S.

4507. Neutrino Theory of Light. V. Fock. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 15. 5. *pp.* 242–244, 1937. *In German.*—Continuing his previous criticism of the neutrino theory of light [see Abstract 2591 (1937)] the author admits the replies of Nath and Stueckelberg which indicate that by the introduction of antineutrinos operators satisfying Jordan's interchange relations can be constructed. He shows, however, that fundamental difficulties remain which have a physical origin in the fact that the degree of freedom to which corresponds the transformation of a particle from a neutrino into an antineutrino cannot be found in nature. W. S. S.

See also Abstracts 4499, 4746.

REFLECTION, REFRACTION AND DISPERSION.

4508. Refractive Indices of Mixtures of Aniline and *o*-Chlorophenol. C. D. Ellyett. *Faraday Soc., Trans.* 33. *pp.* 1212–1217, *Sept.*, 1937.—Refractive indices of anhydrous aniline—*o*-chlorophenol mixtures are measured. The extent of departure of the molar refractivities from the mixture law is found to be no greater than the experimental error; but Smyth's argument for dipole association is criticised, and a resonance linkage for the compound is proposed. The stability of chelation in *o*-chlorophenol is discussed. AUTHOR.

4509. Application of Hartmann Dispersion Formula to Thin Double Lenses. H. Slevogt. *Zeits. f. Instrumentenk.* 57. *pp.* 337–342, *Aug.*, 1937.—It is shown in Part I that the linear relation noted by Harting between the Abbe number v and the constant λ_0 of the Hartmann dispersion formula is equally significant with the linear connexion noted by König between v and the relative partial dispersion θ. As an additional result the connexion is obtained between the constants C_0 and λ_0 of the Hartmann formula in dependence on x. In Part II under certain assumptions already made from two lenses, whose dispersion curves are produced by the Hartmann formula, objectives can be constructed whose colour curves show extreme values as for the apochromat and fluorite systems. R. S. R.

4510. Optical Glassworks at Benediktbeuern. W. H. S. Chance. *Phys. Soc., Proc.* 49. *pp.* 433–443, *Sept.* 1, 1937.

∗4511. Ultramicroscope for Metals. F. Burmistrov. *Techn. Phys., U.S.S.R.* 4. 4. *pp.* 325–329, 1937. *In English.*—The types of instrument already in use for visual study or for photographic recording of structural change resulting from methods of working and other factors are discussed but the test piece may not be a true sample. The defects of illumination of these instruments are discussed. A new ultramicroscope is described which is used to examine surfaces while under construction using the same focus or various magnifications. With this instrument polishing can be continued until all scratches are eliminated. R. S. R.

4512. Optical Flatness. E. Einsporn. *Zeits. f. Instrumentenk.* 57. *pp.* 265–285, *July*, 1937.—The degree of accuracy attainable in refraction measurements depends upon the flatness of the prism faces or plates used. In practice a departure of 10^{-5} mm. from flatness is the minimum directly attainable by grinding or polishing and further attempts at correction may mar the result. Testing methods depending upon interference are described, together with the theory of the methods and the results obtained. R. S. R.

∗4513. High-Precision Refractometer. A. Arnulf and Niuta Winter-Klein. *Rev. d'Optique*, 16. *pp.* 267–272, *Aug.*, 1937.—In determining the refractive index of a sample by having it in contact with a reference prism error arises from the two surfaces not being parallel. In the method described this error is avoided by having light passing through the prism in two directions with the ray paths coinciding and reflected at the interface of sample and prism. The rays converge again at the eyepiece. By suitable choice of refractive index for the prism and measurement of the angle of emergence of the rays a precision of 1×10^{-6} can be obtained for the refractive index of the sample. With a photographic arrangement tests can be made from the u.v. to the infra-red. R. S. R.

∗4514. Illumination Characteristics of the Camera Lens. F. Benford. *J.O.S.A.* 27. *pp.* 286–287, *Aug.*, 1937.—On theoretical grounds it is shown that for an ideal thin lens the illumination at the film $\propto \cos^4 \theta$. For an actual thick lens the effect is greater and in a diagram the illumination is shown for various film widths and iris settings. The effect is of importance for photographic photometry. R. S. R.

See also Abstracts 4233, 4417, 4457, 4458, 4459, 4464, 4475, 4489, 4490, 4574, 4575, 4576, 4594.

SPECTROSCOPY.

4515. Effective Cross-Section for Excitation of the D-Lines by Collision of Na-Ions and He. W. Maurer and K. Mehnert. *Zeits. f. Physik*, 106. 7–8. *pp.* 453–457, 1937.—The D lines of Na emitted during collision of Na^+ and He are interpreted as a charge-transfer phosphorescence. Their intensity is proportional to pressure and current strength, and the effective cross-section for their production is much smaller than the total cross-section for charge transfer. The occurrence of alkali arc lines during collision of alkali ions with He, Hg or H_2 is discussed. [See also Abstracts 4699 and 5648 (1936).] C. B. A.

4516. Fine Structure of Dα. Maria Heyden. *Zeits. f. Physik*, 106. 7–8. *pp.* 499–517, 1937.—The fine structure of Dα under different experimental conditions has been examined and compares well with theoretically predicted values. Three of the five theoretically required transitions are present under all experimental conditions ; the other two are found under special conditions. W. R. A.

***4517. Attempt to Observe the Spectrum of Doubly Excited Helium. F. P. Bundy.** *Phys. Rev.* 52. *pp.* 452–453, *Sept.* 1, 1937.—In this paper is described an electron-impact discharge tube which was designed to give excitation conditions favourable to the production of doubly excited He. The tube furnished a concentrated 1000 mA beam of 300 to 500 V electrons which passed through purified He at a pressure of approximately 0·01 mm. Hg. The comparatively feeble glow produced was photographed with a high speed two-prism glass spectrograph. Long exposures yielded only very much over-exposed HeI lines and rather strong HeII lines. This result is consistent with certain approximate theoretical calculations of Kreisler which show that the lifetimes of the doubly excited states of He are limited by autoionisation to approximately 10^{-14} sec., so that any spectral " lines " would be far too broad to be observable. This result tends to weaken the argument that the far u.v. He lines, 320·4 and 357·4 Å, found by Kruger, and by Compton and Boyce, are due to transitions from doubly excited states to singly excited ones ; and that the 60-V energy losses of electrons passing through He, observed by Whiddington, are due to a transition from the ground state to a doubly excited state. AUTHOR.

4518. Extreme Ultra-Violet Spectra of Sc VI, Sc VII and Other Elements Isoelectronic with P I and S I. P. G. Kruger and H. S. Pattin. *Phys. Rev.* 52. *pp.* 621–625, *Sept.* 15, 1937.—The spectra of Sc, Ti, V and Cr have been photographed in the region 80 to 700 Å with a large grazing incidence vacuum spectrograph. The irregular doublet law and constant second difference law have been used to aid in the identification of multiplets in ions of these elements. In the S I isoelectronic sequence, Sc VI multiplets involving the $3s^23p^4\ {}^3P, {}^1D, {}^1S - 3s3p^5\ {}^3P^0$; $3s^23p^34s\ {}^3S^0$, ^{1}, $^3D^0$, ^{1}, $^3P^0$ terms and the Ti VII multiplet involving the $3s^23p^4\ {}^3P - 3s3p^5\ {}^3P^0$ terms have been observed. A number of intercombination lines have been identified, making possible an accurate calculation of the term values relative to the ground state. In the P I isoelectronic sequence, Sc VII multiplets involving the $3s^23p^3\ {}^4S^0, {}^2D^0, {}^2P^0 - 3s^23p^24s\ {}^4P, {}^2D, {}^2P$ and $3s3p^4\ {}^4P$ terms ; Ti VIII multiplets involving the $3s^23p^3\ {}^4S^0, {}^2D^0, {}^2P^0 - 3s^23p^24s\ {}^4P, {}^2P, {}^2D$ terms ; and V IX multiplets involving the $3s^23p^3\ {}^4S^0, {}^2D^0 - 3s^23p^24s\ {}^4P, {}^2D$ terms have been observed. Since no intercombination lines have been observed it is impossible to assign relative term values to the doublet and quartet systems. AUTHORS.

4519. Absorption Spectrum of Thulium Sulphate. H. A. Bethe and F. H. Spedding. *Phys. Rev.* 52. *pp.* 454–455, *Sept.* 1, 1937.—Evidence is presented in support of the assumption that the absorption spectra of salts of the rare earths are due exclusively to transitions within the $4f$ shell. It is shown that semi-quantitative agreement is obtained in the case of Tm salts. A. H.

4520. Third Spectrum of Cerium (Ce III). H. N. Russell, R. B. King and R. J. Lang. *Phys. Rev.* 52. *pp.* 456–466, *Sept.* 1, 1937.—33 triplet and singlet terms of Ce III have been recognised, and account for 294 lines, including almost all of wave-length exceeding 2000 Å. The electron configurations $4f5d$, $4f6p$, $(5d)^2$, $4f6s$, $4f6d$, and $5d6s$, have been almost completely identified. The last three show evidence of JJ coupling. Zeeman data by de Bruin and King confirm the classification. The lowest known level is $4f5d\ ^1G_4$ and the ionisation potential from this to $4f\ ^2F2\frac{1}{2}$ of Ce IV is 19·5 V. The $(4f)^2$ configuration may be lower, but has not been discovered, as its combinations lie in the infra-red and the far ultra-violet. The ultimate lines must be in the infra-red, as is probably the case for the third spectrum of most of the rare earths. AUTHORS.

4521. Extension of Analysis of Sm I Spectrum. W. Albertson. *Phys. Rev.* 52. *pp.* 644–647, *Sept.* 15, 1937.—The term $4f^6(^7F)6s7s\ ^9F$ has been found, which yields 5·6 V as the approximate ionising potential of Sm I. The triad of terms $4f^6(^7F)6s6p\ ^9GFD^0$ have been completely identified. Several new energy states have been located, which account for all previously unidentified low temperature lines. Experimental proof of the existence of more than 910 energy states which are necessary to account for existing data is pointed out. The extreme difficulty of analysing the remaining data is discussed. [See also Abstract 1626 (1935).] AUTHOR.

4522. Intensities of Lines of Titanium and Vanadium. S. A. Borovik and T. T. Borovik-Romanova. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 15. 9. *pp.* 543–546, 1937. *In French.*—While investigating carbon and graphite rods for spectrum analysis, it has been found that the introduction into the arc of KCl, NaCl, Pb_3O_4, SiO_2 and K_2CO_3 causes an increase in intensity of some of the lines of Ti and V. The effect is much more pronounced in the case of arc lines (Ti_I, V_I) than for spark lines (Ti_{II}, V_{II}). The effect on C itself could not be determined as only the 2478 Å line was observed. F. S.

4523. Null Method of Estimating the Half-Life Periods of Metastable Atomic States. W. Lippert. *Ann. d. Physik,* 30. 2. *pp.* 136–150, *Sept.*, 1937.—Experimental details and results for A and Ne are given. W. R. A.

4524. Band (1,2) and Predissociation of Level C^3 in the Second Positive System of N_2. P. Trautteur. *N. Cimento,* 14. *pp.* 222–227, *May,* 1937.—In a low-pressure arc the rotational lines can be obtained up to a rotational quantum number of 71. This result is compared with measurements of other authors on other bands of the same system and it is concluded that the fading-out at 71 is due to predissociation. R. P.

4525. Far Infra-Red Spectrum of Water Vapour. H. M. Randall, D. M. Dennison, N. Ginsburg and L. R. Weber. *Phys. Rev.* 52, *pp.* 160–174, *Aug.* 1, 1937.—This is a continuation of work by Wright and Randall [see Abstract 4521 (1933)], using the spectrometer designed by Randall [see Abstract 3230 (1932)], but somewhat improved. Single lines have been determined to about 0·05 cm^{-1}. and lines as close as 0·5 cm^{-1}. separated and measured. Rotational energy levels of the water molecule have been found to an accuracy around 0·1 cm^{-1}. The highest level possesses an energy of over 3200 cm^{-1}., while all with energies less than 2000 cm^{-1}. have been obtained. All allowed transitions with their intensities are calculated and found to agree well with the observed spectrum. F. S.

4526. Near Infra-Red Absorption of Coloured Inorganic Salt Solutions. T. Dreisch and W. Trommer. *Zeits. f. phys. Chem.* 37. *Abt.B.* 1–2. *pp.* 37–59, 1937.—The absorption of a number of Cu, Ni, Co and NH_4 salts in the short wave infra-red has been investigated with the following results: (1) The absorption maxima of pure water at 0·98 and 1·46 μ have been split into two maxima at 0·98 and 1·01, and 1·445 and 1·468 μ respectively. It was established that certain Ni salts in aqueous solution have equal absorption both qualitatively and quantitatively. A like phenomenon is shown by certain aqueous solutions of Co salts and also by Cu salts with the exception of the acetate. By transition from aquo- to ammino-complexes, a displacement of the absorption maximum by 1930 cm^{-1}. to the shorter wave lengths was found for Cu salts together with a doubling of the intensity. With nickel ammino-complex salts a displacement of 2030 cm^{-1}. takes place as compared with the maximum of the aquo-salts and a quadrupling of the intensity. For 8 complex salts of trivalent cobalt there is no absorption in the infra-red. Two new bands at 1·8 and 2·15 μ have been found for the ammonium radical. Experimental details are included. H. H. Ho.

*4527. **Spectrum of Acetylene in the Photographic Infra-Red. G. W. Funke and E. Lindholm.** *Zeits. f. Physik*, 106. 7–8. *pp.* 518–531, 1937.—Improvements in apparatus are discussed. Nine new bands in the rotation-vibration spectrum of C_2H_2 are recorded and analysed whilst bands already known have been examined under greater dispersion and their Q branches studied. Measurement of the bands at 7556 and 9600 Å leads to an accurate value for the ν_0 values of the symmetrical deformation vibration. Dennison's intensity formula does not hold quantitatively for C_2H_2. The energy necessary to dissociate a C-H linking is considered. [See Abstract 1234 (1937).] W. R. A.

4528. Absorption Spectra of Pyrrol Dyestuffs. Franziska Pruckner and A. Stern. *Zeits. f. phys. Chem.* 180. *Abt.A.* 1. *pp.* 25–43, 1937.—Characteristic double banded absorption spectra are afforded by certain pyrromethenes. Introduction of alkyl groups into the pyrromethene system causes a displacement of the absorption bands towards the red, while similar displacements are also produced by carbethoxy-groups which, however, depend on their positions, so that isomeric dicarboxy-pyrromethenes may be identified by the differences of their absorption spectra, and the configurations of the carbethoxy-groups thereby established. Oxy-groups cause a displacement towards the blue. The absorption spectra of some bilirubinoids are also described, mainly those in which one or more of the chromophores are not conjugated with each other in the pyrromethene system. It is concluded that the pyrromethene structure is present in the fundamental systems of urobilin (bili-en-system) and mesobilirubin (bili-dien-system). The changes found in the spectrum of glaucobilin which possesses three pyrrolenin nuclei and one pyrrol nucleus (bili-trien-system) are also described. The presence or absence of a pyrromethene structure in a bilirubinoid is clearly indicated in the absorption spectra. H. H. Ho.

4529. Mutual Optical Influence of Chromophores in the Molecule. W. Aumüller, H. Fromherz and C. O. Strother. *Zeits. f. phys. Chem.* 37. *Abt.B.* 1–2. *pp.* 30–36, 1937.—From a consideration of previous measurements together with light absorption data for aliphatic dibromides and di-iodides in relationship to the respective distances of halogens, the following rules have been derived: (1) The absorption of simple chromophores is additive so long as these groups are separated by at least one CH_2-group. (2) Whenever two chromophores are adjacent to each other, mutual influence occurs resulting in displacement of absorption towards the longer wave-lengths (deepening of colour). (3) This influence and absorption displacement is still further increased when the H-atoms adjacent to the chromophores are replaced by alkyl groups whose varying composition is almost inappreciable. (4) The effects are the same whether the chromophores contain double bonds or not (Br,I) ; a conjugated double bond is thereby in no way determinative of the effect of the chromophore, whereas the specific characteristics, such as polarisation and polarisability, are decisive. H. H. Ho.

4530. Absorption Spectrum of Solid Anhydrous Cobalt Chloride. O. R. Howell and A. Jackson. *Chem. Soc., J. pp.* 973–979, *June*, 1937.—Absorption spectra (using scattered light) of solid anhydrous $CoCl_2$ were examined using a variety of supports (filter paper, Jena sintered glass, etc.) for the salt. Though variations in the relative intensities of the bands with support were noted, all the spectra showed bands in both red and blue corresponding respectively with Co ion in association with 4 and with 6 Cl ions. At liquid-air temperature, $CoCl_2$ is red to the eye ; at room-temperature it is still essentially red, but at higher temperatures (70°–220°) there is a distinct relative increase in red absorption (*i.e.*, in blue colour), comparable with the behaviour of the salt in HCl solutions of increasing HCl normality. Crystal structure (powder method) gives no indication of any change in disposition of four of the six Cl ions surrounding each Co ion, but further investigation of the lattice may reveal a slight change in spacing which might give rise to appreciable changes in association. [See Abstract 4278 (1937).]

L. V. C.

4531. Absorption Spectra of Cobalt Chloride Solutions. Á. v. Kiss and M. Gerendás. *Zeits. f. phys. Chem.* 180. *Abt.A.* 2. *pp.* 117–130, 1937.—Molecular extinction coefficients are recorded for $CoCl_2$ dissolved in water, in aqueous solutions of HCl, of various chlorides, of $Na_2S_2O_3$ and of $CoSO_4$, and in $CoSO_4$ in H_2SO_4. The absorption curve for $Co(ClO_4)_2$ in water is also measured as a standard for comparison. Various types of absorption spectra are observed. The marked dependence of the $CoCl_2$ spectrum on concentration is attributed to complex formation, but the exact nature of the complexes remains unsolved. C. B. A.

4532. Absorption of Light by Porphyrins. Part XII. A. Stern and M. Deželić. *Zeits. f. phys. Chem.* 180. *Abt.A.* 2. *pp.* 131–138, 1937.—In continuation of previous work [see Abstract 3594 (1937)], the influence of metal atoms on the absorption spectrum of mesoporphyrin-IX-dimethylester is studied. The spectra of various metallic complexes exhibit marked differences, which are attributed to the various states of combination of the metal atoms in the porphin system. C. B. A.

4533. Absorption Spectra of Alkaline-Earth Monosulphides and Their Latent Heats of Vaporisation. L. S. Mathur. *Roy. Soc., Proc.* 162*A*. *pp.* 83–94, *Sept.* 1, 1937.—The paper contains a study of absorption spectra of the sulphides of alkaline earth elements. Two regions of absorption have been reported for SrS and BaS, while for CaS only one region of absorption in far ultra-violet has been observed. From the long wave-length limits of the first continuous absorption latent heats for CaS, SrS and BaS have been found to be 82·39 k.cal., 184·10 k.cal. and 136·46 k.cal. respectively. The value of $^3P - {}^1D_2$ term difference for S has been found to be 0·72 eV, which is less than 1·14 eV obtained from the atomic spectrum. It has been explained with the help of Franck-Condon energy diagrams. AUTHOR.

4534. Absorption Spectrum of Formic Acid in the Vacuum Ultra-Violet. W. C. Price and W. M. Evans. *Roy. Soc., Proc.* 162*A*. *pp.* 110–120, *Sept.* 1, 1937.—Formic acid is found to possess a large number of discrete absorption bands in the region below 1550 Å. These consist of numerous electronic transitions each of which is represented by a short vibrational pattern. These patterns are strong and well separated at long wave-lengths but become weaker and overlap towards shorter wave-lengths, eventually merging into an ionisation continuum around 1095 Å or 11·3 eV. Reasons are given for the belief that the excitation and removal of the lone pair electrons from the carbonyl O atom is responsible for the greater part of this absorption spectrum. AUTHORS.

4535. Molecular Spectra of Zinc Hydride and Deuteride. Y. Fujioka and Y. Tanaka. *Inst. Phys. and Chem. Research, Tokyo, Sci, Papers, No.* 718. *pp.* 143–156, *Aug.*, 1937. *In English.*—The $^2\Pi \rightarrow {}^2\Sigma$ bands of ZnH and ZnD in the violet region are photographed with the use of a 6-m. concave grating in the second order. In each case, twelve branches of O→O bands are analysed and the constants of $^2\Sigma$ and $^2\Pi$ states are calculated. As the vibrational levels are not observed at all, the constants of the electronic states (Be, De, etc.) are not calculated therefore it is difficult to discuss the isotope effect precisely. AUTHORS.

4536. Ultra-Violet Bands of Magnesium Hydride. L. A. Turner and W. T. Harris. *Phys. Rev.* 52. *pp.* 626–630, *Sept.* 15, 1937.—Extension of the $^2\Pi^* - {}^2\Sigma$ system of MgH leads to the following values of the constants of the $^2\Pi^*$ state. $B_0' = 6 \cdot 090$, $B_e' = 6 \cdot 159$, $D_0' = -3 \cdot 1 \times 10^{-4}$, $\omega_e' = 1709$, $B_1' = 5 \cdot 951$, $\alpha' = 0 \cdot 139$, $D_1' = -2 \cdot 9 \times 10^{-4}$, $\omega_e'\chi_e' = 43 \cdot 3$. Previous erroneous assignments of K values in the bands of both MgH and MgD are corrected. Difficulties in the interpretation of the λ2348 band of MgH and λ2360 band of MgD are discussed. AUTHORS.

4537. Ultra-Violet Band-Systems of GeCl and GeBr. W. Jevons, L. A. Bashford and H. V. A. Briscoe. *Phys. Soc., Proc.* 49. *pp.* 532–542, *Sept.* 1, 1937.—Band systems of GeCl and GeBr are developed in the regions λ3202–λ2847 and λ3260–λ2946 respectively in heavy-current tube-discharges through continuous flows of $GeCl_4$ and $GeBr_4$ vapours. Each consists of two sub-systems of bands degraded towards shorter wave-lengths, the heads being represented approximately by

$$\text{GeCl}: \nu = \begin{Bmatrix} 33992 \cdot 2 \\ 33017 \cdot 2 \end{Bmatrix} + (526 \cdot 6u' - 0 \cdot 3u'^2) - (408 \cdot 4u'' - 1 \cdot 6u''^2),$$

$$\text{GeBr}: \nu = \begin{Bmatrix} 33413 \cdot 4 \\ 32263 \cdot 4 \end{Bmatrix} + (383 \cdot 7u' - 0 \cdot 7u'^2) - (296 \cdot 6u'' - 0 \cdot 9u''^2),$$

where $u = v + \frac{1}{2}$. The systems are probably $^2\Sigma \rightarrow {}^2\Pi$, the lower states, with electronic intervals 975 and 1150 cm^{-1}. respectively, being the ground states of GeCl and GeBr. The electronic intervals $\delta\nu_e$, the upper state energies (system-origins)ν_e, and the vibrational coefficients ω_e and $x_e\omega_e$ for both electronic states are compared with those of band-systems of other monohalides of group-IV (*b*) elements. With increasing atomic number and mass of either atom (group-IV (*b*) or halogen) the expected trend is observed in each case, namely an increase in $\delta\nu_e$, and decreases in ν_e, ω_e and $x_e\omega_e$, except for $\delta\nu_e$ in SiBr and the Pb monohalides; the apparent anomalies are discussed. AUTHORS.

4538. Ultra-Violet Band-System of GeO. W. Jevons, L. A. Bashford and H. V. A. Briscoe. *Phys. Soc., Proc.* 49. *pp.* 543–553, *Sept.* 1, 1937. The GeO band-system, recently investigated by Shaw [see Abstract 702 (1937)] between λ2989 and λ2441 in the flame surrounding an arc charged with GeO_2, has been measured over the larger range λ3319–λ2441 in an uncondensed discharge through a mixture of $GeCl_4$

vapour and oxygen flowing continuously through the discharge tube. The number of bands measured is increased from 18 to 32, and the highest observed value of v'' from 5 to 10. The band-heads of the extended system are approximately represented by $\nu = 37762 \cdot 4 + (651 \cdot 3u' - 4 \cdot 24u'^2) - (985 \cdot 7u'' - 4 \cdot 30u''^2)$, where $u = v + \frac{1}{2}$. This system being attributed to ^{74}GeO, a few other observed heads may be due to ^{72}GeO and ^{70}GeO. Rotational analysis being impossible, there is no further evidence for or against the transition $^1\Pi \rightleftarrows {}^1\Sigma$ suggested by Shaw. The data are compared with those for band-systems of other monoxides and monosulphides of group-IV (*b*) elements, and the observed decreases of ν_e, ω_e and $x_e\omega_e$ with increasing atomic number or mass of either atom are shown graphically. AUTHORS.

4539. Ultra-Violet Band Systems of SnBr and SiBr. W. Jevons and L. A. Bashford. *Phys. Soc., Proc.* 49. *pp.* 554–567, *Sept.* 1, 1937.—The u.v. systems of SnBr and SiBr, as developed in heavy-current tube-discharges through continuous flows of $SnBr_4$ and $SiBr_4$ vapours, are investigated in relation to those of other monohalides of group IV (*b*). For SnBr there are two systems:

(*a*) at λλ3428–3021, of bands degraded towards the further u.v.,

$$\nu_{\text{head}} = \begin{Bmatrix} 33094 \cdot 5 \\ 30627 \cdot 5 \end{Bmatrix} - (247 \cdot 1v'' - 0 \cdot 62v''^2);$$

(*b*) at λλ3709–4255, of bands degraded towards the red,

$$\nu_{\text{head}} = \begin{Bmatrix} 26654 \cdot 3 + (162 \cdot 3v' - 6 \cdot 8v'^2) \\ 24557 \cdot 9 + 163 \cdot 6v' \end{Bmatrix} - (247 \cdot 1v'' - 0 \cdot 62v''^2).$$

These appear to be the analogues of the $^2\Sigma \rightarrow {}^2\Pi$ and $^2\Delta \rightarrow {}^2\Pi$ systems, respectively, of SnCl. The electronic separation in the common $^2\Pi$ state is 2467 cm^{-1}., and that in the $^2\Delta$ state is 371 cm^{-1}. Matters of doubt or difficulty in the analysis are discussed. Miescher's analysis of the SiBr system is modified to include a few hitherto unobserved band-heads and to conform to the doublet transition $^2\Sigma \rightarrow {}^2\Pi$ suggested by analogy to the SiCl and GeBr systems. The more probable of two expressions representing the new measurements is

$$\nu_{\text{head}} = \begin{Bmatrix} 33571 \cdot 0 \\ 33153 \cdot 0 \end{Bmatrix} + (573 \cdot 6u' - 3 \cdot 1u'^2) - (425 \cdot 4u'' - 1 \cdot 5u''^2),$$

where $u = v + \frac{1}{2}$, and the electronic separation in the $^2\Pi$ state is 418 cm^{-1}. The values of the constants for the $^2\Pi$ ground states and $^2\Sigma$ excited states of the monochlorides and monobromides of group IV (*b*) are studied graphically. AUTHORS.

4540. Cameron Bands ($^3\Pi - {}^1\Sigma$) of Carbon Monoxide. L. Gerö, G. Herzberg and R. Schmid. *Phys. Rev.* 52. *pp.* 467–471, *Sept.* 1, 1937.—The $0-0$ and $1-0$ Cameron bands of CO are investigated in absorption with high dispersion. Three P, three Q and three R branches are observed for each band. New accurate values for the rotational constants of the ground state of CO are derived: $B_e = 1 \cdot 9310$ cm^{-1}., $\alpha = 0 \cdot 01744$ cm^{-1}. and, using Bearden's values for *e*, *h* and N, we obtain the moment of inertia $I_e = 14 \cdot 456 \cdot 10^{-40}$ g.cm^2., $I_0 = 14 \cdot 521 \cdot 10^{-40}$ g.cm^2., the nuclear distance $r_e = 1 \cdot 127$ Å, $r_0 = 1 \cdot 129$ Å. From the way in which the Λ doublets of the $a^3\Pi$ state combine with the $^1\Sigma^+$ ground state it can be definitely shown that the upper state of the third positive group of CO (whose lower state is $a^3\Pi$) is $^3\Sigma^+$, not $^3\Sigma^-$. For the electronic excitation energy of the $a^3\Pi$ level a value 48473·7 cm^{-1}. is obtained which differs to some extent from the values at present used in the literature.

AUTHORS.

4541. Analysis of New Band System of the C_2 Molecule. J. G. Fox and G. Herzberg. *Phys. Rev.* 52. *pp.* 638–643, *Sept.* 15, 1937.—The 0–3, 0–4, 0–5 and 0–6 bands of a new band system of the C_2 molecule are analysed. The lower state, $^3\Pi$, is the same as the lower state of the Swan bands (in all probability the ground state). The upper state is a new $^3\Pi_g$ state. The rotational and vibrational constants of the upper and lower state are given. While the constants for the upper state are entirely new those for the lower state (ground state) are considerably improved over those at present in the literature. The triplet splitting and staggering in the new bands is much larger than in the Swan system. In the $^3\Pi_0$–$^3\Pi_0$ component a reversal of the staggering is observed. The electron configuration of the new state is briefly discussed. Finally a number of other bands, very probably due to C_2, but not yet analysed, are given.

AUTHORS.

4542. Hydrogen Flame Spectrum. V. Kondratjew and M. Ziskin. *Acta Physicochimica*, 7. 1. *pp.* 65–74, 1937. *In English.*—The spectrum of the dilute flame of electrolytic gas is studied. The intensity distribution in the OH bands differs from that found in ordinary flames on account of the comparatively low temperature. The relative intensities of the bands 3064 (0′0″), 2811 (1′0″) and 2875 (2′1″) correspond closely to the respective transition probabilities, and it is shown that excitation to the levels $v' = 0,1$ and 2 of the OH molecule takes place in a single elementary act and that the heat of reaction of the process $H + H_2 + O_2 = H_2O + OH$ is the source of the excitation energy. From the measurements of the absolute intensity of the OH spectrum it is shown that (1) the latter is of chemical origin and (2) approximately one excited OH molecule is formed in the zone of the dilute flame for every 10^6 molecules of water produced.

AUTHORS.

4543. Vibration Spectra and Molecular Structure. Part III. Infra-Red Absorption Spectra of Cyclopropane and Ethylene Oxide. L. G. Bonner. *J. Chem. Phys.* 5. *pp.* 704–706, *Sept.*, 1937.—With a rock-salt prism spectrometer, the infra-red absorption spectra of gaseous cyclopropane and ethylene oxide have been mapped in the region 1–15·5μ. Cyclopropane shows bands at 6250, 4425, 3086, 2525, 2088, 1887, 1739, 1429, 1021, 860 and 671 cm^{-1}., while ethylene oxide absorbs at 6211, 4310, 3891, 3021, 2632, 2304, 2024, 1733, 1626, 1493, 1255, 1134, 862, 804 and 696 cm^{-1}. In addition to these infra-red measurements, a redetermination was made of the Raman spectrum of liquid ethylene oxide. Raman lines appeared at 807, 867, 1123, 1269, 1488, 2914, 2958 and 3007 cm^{-1}. [For Part II see Abstract 2646 (1937).]

AUTHOR.

4544. Rotational Quantum Numbers in Single Q Branches. L. A. Turner and W. T. Harris. *Phys. Rev.* 52. *pp.* 630–631, *Sept.* 15, 1937.—A graphical method is given for determining the rotational quantum numbers and rotational constants of Q branches. It is applicable to a single band. It seems to be more accurate than methods used hitherto.

AUTHORS.

4545. Rotational Isotope Effect in the Band Spectra of CdH and CdD. O. Deile. *Zeits. f. Physik*, 106. 7–8. *pp.* 405–417, 1937.—The 0–0 bands of the $^2\Pi$–$^2\Sigma$ transition of CdD are analysed, and the results compared with those of Svensson for CdH, under conditions allowing of great precision. It is found that for the ground term $^2\Sigma$ the spin separation diminishes with increasing nuclear mass in agreement with van Vleck's formula, and the Λ-doubling of the $^2\Pi$ term is diminished. The spin separation of the $^2\Pi$ term increases with the mass. All differences between CdH and CdD can be attributed to mass effects. C. B. A.

4546. Rotation Constants of Diatomic Molecular Terms from Perturbation Data. I. Kovács. *Zeits. f. Physik*, 106. 7–8. *pp.* 431–438, 1937.—The rotation and vibration constants of $I^1\Sigma^-$ terms of CO, which arise from perturbation of the $A^1\Pi$ states, are determined. W. R. A.

4547. Band Spectrum of Mercury Vapour. S. Mrozowski. *Zeits. f. Physik*, 106. 7–8. *pp.* 458–462, 1937.—It is shown that owing to an error in the analysis of the band spectrum of Hg_2 given in previous papers [see Abstracts 1181 (1934) and 1679 (1937)] the classification of terms and the course of two of the potential curves there given require modification. The corrections are carried through and their bearing on the theory of the fluorescence phenomena is discussed. W. S. S.

4548. Absorption Spectra of Carbon and Tin Halides in the Vapour State. Y. P. Parti and R. Samuel. *Phys. Soc., Proc.* 49. *pp.* 568–586, *Sept.* 1, 1937. The absorption spectra of the vapours of $SnCl_4$, $SnBr_4$ and of molecules of the types CX_4, CHX_3, and CH_2X_2(X = Cl, Br, I) are investigated. From the number of maxima and their energy differences, and a comparison of the beginnings of the various absorption regions with thermochemical data, it is concluded that the first process of photodissociation corresponds not to the process $MX_4 \rightarrow MX_3 + X$ but to $MX_4 \rightarrow MX_2(^1\Sigma) + 2X$ etc.; the further absorption regions are due to one or two excited halogen atoms. AUTHORS.

4549. Continuous Absorption Spectrum of Chlorine in the Region 4000-5000Å. R. G. Aickin and N. S. Bayliss. *Faraday Soc., Trans.* 33. *pp.* 1333–1338, *Sept.*, 1937.—Values of the absorption coefficient of Cl_2 in the spectral region 4000–5400 Å are recorded at six temperatures from 18° to 709° C. A temperature analysis of the results reveals that the continuous absorption spectrum of Cl_2 contains two components, designated as A and B. A has $\epsilon_{max} = 66$ at 3300 Å, and is due to the transition $^1\Pi_u \leftarrow {}^1\Sigma_g{}^+$, which leads to dissociation into normal atoms. B is much weaker, with $\epsilon_{max} \approx 1$ at about 4250 Å, and is a composite of the transitions $^3\Pi_{1u} \leftarrow {}^1\Sigma_g{}^+$ and $^3\Pi_{0+u} \leftarrow {}^1\Sigma_g{}^+$ (corresponding to the visible bands), producing dissociation into $Cl(^2P_{1\frac{1}{2}}) + Cl(^2P_{1\frac{1}{2}})$ and $Cl(^2P_{1\frac{1}{2}}) + Cl(^2P_{\frac{1}{2}})$ respectively. [See following Abstract.] AUTHORS.

4550. Continuous Absorption Spectrum of Chlorine and the Photosynthesis of Hydrogen Chloride. N. S. Bayliss. *Faraday Soc., Trans.* 33. *pp.* 1339–1342, *Sept.*, 1937.—Various features of the photosynthesis of HCl (in the absence of O_2) have been discussed in the light of recent work on the continuous absorption of Cl_2. It is shown that the only primary process that need be assumed is the photodissociation of Cl_2 into atoms, and that in accordance with this, the quantum yield, the temperature coefficient, and the energy of activation of the reaction are practically independent of the wave-length of the exciting radiation. The slight change of quantum yield with wave-length, that has been observed at low gas pressures only, is interpreted in terms of a difference between $Cl(^2P_{\frac{1}{2}})$ and $Cl(^2P_{1\frac{1}{2}})$, either in starting reaction chains or in reacting with inhibitors. [See preceding Abstract.] AUTHOR.

4551. Band Analysis of Scintillation Spectra Excited in ZnS Phosphors by α-Particles. W. Kutzner. *Zeits. f. Physik,* 106. 9–10. *pp.* 551–571, 1937.—The spectra of the scintillations excited by α-particles in ZnS phosphors of known composition are carefully analysed and it is found that the band spectra can easily be resolved into separate bands. The influence of the addition of foreign metals and melts on the distribution of intensity in the spectra is investigated. C. B. A.

4552. Absorption and Luminescent Spectra of Uranyl Salts and their Solutions. W. L. Lewschin. *Acta Physicochimica,* 6. 5. *pp.* 661–688, 1937. *In English.*—Comparison is made between the absorption and luminescent spectra of the individual salts and between their changes with temperature and solution. Changing the anion produces a considerable shift of frequency and a marked effect on the intensity. The energy distribution within the emission spectra, however, is very similar for all salts; the spectra consisting essentially of five bands whose relative intensity is much the same for all salts. Solution and change of temperature strongly affect the distribution of intensity and lead to blurring but do not appreciably affect the positions. The last fact indicates that the emitter is the undissociated molecule. The absolute value of the absorption is very small and indicates that the life period of excitation is large. The law of mirror symmetry holds good, but not exactly, which is explained by the difference in structure of the upper and lower energy states of the molecule. Qualitatively the mirror correspondence is found to hold good both as regards the structure of the individual bands and the contour of absorption and emission spectra. J. E.

4553. Band Fluorescence of Alkali Halides containing Oxygen or Carbon Dioxide. W. Honrath. *Ann. d. Physik,* 29. 5. *pp.* 421–432, *July,* 1937.—Oxysalts which are easily decomposed when added to a melt of alkali halide produce fluorescence centres which are independent of the kind of oxysalt added. The emission spectra are, in chlorides, bromides and iodides, closely alike, consisting of a number of equidistant bands separated by about 0·12 V. At low temperatures the bands are sharp; at — 235° C., for instance, in the case of KCl, attaining the sharpness of spectral lines. The same kind of centres are produced by diffusion of O_2 into heated crystals. It is considered that they consist of complexes of ClO_4 which are symmetrical and little influenced by the lattice. Simultaneous treatment of an alkali halide with K vapour and CO_2 gives a phosphorescent product whose spectra are identical with those obtained by Roos. [See Abstract 5065 (1934).] J. E.

***4554. Combination of Zeeman and Stark Effects on Helium Lines. W. Steubing and F. Stolpe.** *Ann. d. Physik,* 30. 1. *pp.* 1–33, *Sept.,* 1937.—A special form of discharge tube is described in which arrangements are made for subjecting the discharge to magnetic and electric fields at right angles. A 3 m. concave grating was used to photograph the effect. The ratio of field strengths is found to be of importance for all lines. There is a critical value below which lines are broadened and diffuse, while above it they are sharp and split into components. For small values of electric field the Zeeman effect suppresses the Stark effect. Further observations are intended with more powerful apparatus. F. S.

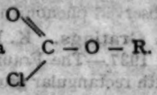
4555. Intensity of the Continuous Raman Effect in Alcohol-Benzene Mixtures. A. Carrelli and F. Cennamo. *N. Cimento,* 14. *pp.* 217–221, *May,* 1937.—The continuous spectrum which surrounds the exciting line does not vary proportionally with the benzene concentration. R. P.

4556. Raman Spectrum of Pyrrol. G. B. Bonino and R. Manzoni-Ansidei. *Accad. Lincei. Atti*, 25. *pp.* 489–493, *May* 8, 1937.—Farther experimental work has been carried out on the Raman spectrum of pyrrol confirming previous work of the authors and also the observations of Reitz. The placing of three lines in the Raman spectrum of pyrrol by Stern and Thalmayer and their interpretation as due to double bonds C = C and C = N of "olefinic" and "pyrrolinic" forms of pyrrol is adversely criticised. A table summarising all these observations is given. The line 3058 cm.$^{-1}$ is attributed to Hg. The discussion remains open whether the pyrrolinic form of pyrrol corresponds to a form stabilised only in some pyrrol derivatives, or whether it should be regarded, if not as a possible individual and definite structural form for the pyrrol molecule, yet as a configuration little probable but structurally possible and in quantic resonance with other possible configurations of the molecule of pyrrol possessing a higher probability. [See following Abstract.] J. J. S.

4557. Raman Spectrum of N–Deutero–Pyrrol. G. B. Bonino and R. Manzoni-Ansidei. *Accad. Lincei, Atti*, 25. *pp.* 494–497, *May* 8, 1937.—Study of the Raman spectrum of N–deutero–pyrrol confirms the explanation already given for the line 3390 cm.$^{-1}$ of pyrrol, bringing distinct support to the hypothesis that pyrrol is able, at least partly, to exist in a form in which the direction of the bond N–H may not be in the same plane as the plane of the ring. [See preceding and following Abstracts.] J. J. S.

4558. Molecular Symmetry of Pyrrol. G. B. Bonino. *Accad. Lincei, Atti*, 25. *pp.* 502–508, *May* 8, 1937.—A comparison is made between the Raman spectrum and the infra-red absorption spectrum of pyrrol. From his own results and those of other investigators the author discusses the possible molecular symmetry of pyrrol, and considers recent work as pointing the way to future fruitful experimental research on the heteroclite pentatomics. [See preceding Abstract.] J. J. S.

4559. Raman Spectra of Two Molecular Forms of PCl_5. H. Moureu, M. Magat and G. Wetroff. *Comptes Rendus*, 205. *pp.* 276–278, *July* 26, 1937.—The Raman effect has been observed on either side of the melting point and an effort made to propose stereochemical models for the molecules in the liquid and solid states. For the former a trigonal bi-pyramid is proposed with P at the centre of the triangular base, Cl at each corner and a further Cl on either side of this plane. The conclusions regarding the solid state do not seem so sure. F. S.

4560. Raman Spectra of Chlorocarbonates. M. S. Joglekar. *Phil. Mag.* 24. *pp.* 405–409, *Sept.*, 1937.—This paper gives a preliminary study of the Raman spectra of a few organic compounds represented by the structural formula  $\mathrm{O{=}C(Cl){-}O{-}R}$. The liquids studied are methyl-, ethyl-, tri-chlor-methyl- and propyl-chlorocarbonates.

4561. Raman Spectra of Acid Bromides. V. N. Thatte and B. V. Thosar. *Zeits. f. Physik*, 106. 7–8. *pp.* 423–430, 1937.—The Raman spectra of the acid bromides show all the vibrations which occur in the spectra of other aliphatic series, the frequency of O = C – Br being about 100 cm^{-1}. lower than that of O = C – Cl, recorded by Kohlrausch. C. B. A.

4562. Raman Effect and Molecular Structure. C. S. Venkateswaran. *Current Science*, 6. *pp.* 5–12, *July*, 1937.—A review embodying a general account of the application of Raman spectra to simple molecules, electrolytic dissociation, influence of change of state on the spectrum, rotational Raman effect and constitutional problems. W. R. A.

4563. Raman Effect and Dipole Moment in Relation to Free Rotation. Part IX. Y. Morino and S. Mizushima. *Inst. Phys. & Chem. Research, Tokyo, Sci. Papers, No.* 723. *pp.* 220–227, *Aug.*, 1937. *In English.*—The authors have discussed [see Abstract 4082 (1937)] various types of intramolecular potentials which are responsible for the hindrance of rotations around the C-C and C-O bonds. So far as the normal state of the molecule can well be approximated by a single structural formula, the hindrance of rotation has been accounted for by the interaction between the rotating groups. There are, however, cases where the rotation axis corresponds to a pure single bond, a phenomenon which is quite inexplicable from the classical chemical theory. S_2Cl_2 is the molecule now considered as belonging to this category, and its internal configuration can only be accounted for by the interaction of the electronic clouds on S atoms. The Raman spectrum was investigated by a special spectrograph of high luminosity and moderately high dispersion, and the dipole moment was also found to be $1 \cdot 0 \times 10^{-18}$ e.s.u. The formula Cl-S-S-Cl is found to represent the facts and its normal vibrations are calculated. H. H. Ho.

4564. Raman Spectra of Camphoric Acids and Anhydrides. B. K. Singh and B. Misra. *Indian Acad. Sci., Proc.* 6*A*. *pp.* 90–96, *July*, 1937.—The Raman spectra of the *d*- and *l*-forms of camphoric anhydride and of camphoric acid in the crystalline state have been studied. The spectra of the two forms are identical, which, therefore, supports Pasteur's law of molecular dissymmetry. The lines due to the vibrations of the CH_2-groups are most intense in these compounds. An intense sharp line at 706 $cm.^{-1}$ in camphoric acid is shifted to 607 cm^{-1}. in its anhydride. These lines have been assigned to the symmetrical oscillations of the neopentyl group. The lines due to the (CH) vibrations are almost identical in the camphoric acid and its anhydride. AUTHORS.

***4565. Polarisation-Interference Fringes in Hilger E 1 Quartz Spectrograph. H. Yoshinaga.** *Japanese Journ. Phys.* 12. *pp.* 1–7, *March*, 1937. *In English.*—Polarisation-interference fringes appearing in quartz spectrographs are especially complex in the case of instruments incorporating a total reflection prism such as the Hilger E 1. In the work described is considered the variation in intensity of the fringes due to (*a*) rotation of the plane of polarisation by the 30° prism and (*b*) variation in the reflecting power of the photographic plate. An equation is obtained which completely explains the observed phenomena. A. H.

***4566. Laminar Reflection Gratings. K. H. Hellwege.** *Zeits. f. Physik*, 106. 9–10. *pp.* 588–596, 1937.—The Fraunhofer diffraction figure of a laminar reflection grating with rectangular groove section is calculated with the aid of Kirchhoff's law and explicitly expressed in a formula. Certain definite wave-lengths lying below a long-wave limit are shown to be missing from the continuous spectrum of the grating; a grating is only useful spectroscopically above this limiting wave-length. From the formulæ grating constants and groove depths can be determined so as to make the grating especially favourable for use in any desired spectral region. J. E. K.

4567. Radiation of a Gaseous Discharge. V. Fabricant. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 15. 8. *pp.* 451–455, 1937. *In English.*—Concerns the mechanism of the emission of radiation in a discharge in which secondary processes play an insignificant part. A formula for the intensity of emission is enunciated in terms of the atomic and electronic concentrations in the positive column, the law of distribution of the electron energies, the excitation potential of the atom and the effective cross-section of the atom for electrons of different velocity. The formula is applied to the sodium discharge (the only case for which the necessary data are available) and the relation between the radiation intensity and the electron temperature is calculated. Satisfactory agreement is obtained with the experimental determination of this relation by Druyvesteyn and Warmoltz. W. S. S.

4568. Fine Structure of Luminous Flashes Produced by the Discharge of a Condenser in Gas. M. Laporte and P. Corda. *J. de Physique et le Radium,* 8. *pp.* 233–234, *June,* 1937.—By the method of the turning mirror a study was made of the luminous flashes produced by the discharge of a condenser in various gases at pressures of several mm. The paper is a continuation of a previous one. [See Abstract 3698 (1936).] The gases investigated were Ne, A, He, Kr. In pure gases the flashes do not show a " fine structure," nor in mixtures in which ionising shocks of the second kind do not occur. In mixtures in which such shocks are possible a fine structure appears at the beginning of the discharge. This discharge may be aperiodic or oscillating. J. J. S.

***4569. Quantitative Spectrum Analysis with an Uncalibrated Stepped Wedge. L. Alifanowa and S. Rajski.** *Techn. Phys., U.S.S.R.* 4. 5. *pp.* 361–364, 1937. *In German.*—It is pointed out that the calibration of the wedge is unnecessary and may introduce errors arising from the method of calibration. The application of an uncalibrated wedge is described. F. S.

See also Abstracts **4255, 4278, 4307, 4362, 4460, 4642, 4645.**

VISION.

4570. Colour Sensation of Congenital Total Colour Blindness. H. Kanazawa. *Imp. Acad. Tokyo, Proc.* 13. *pp.* 200–203, *June,* 1937. *In English.*—Gives the results of brightness matching experiments for three totally colour blind subjects using Ostwald's standard colour papers. W. S. S.

4571. Entoptic Vision of the Retina in Orange-Red Light. P. Fortin. *Comptes Rendus,* 205. *pp.* 254–255, *July* 19, 1937.—Two vascular networks in the retina visible entoptically with the aid of orange-red light and a third visible in blue light are described. W. S. S.

4572. Flicker in Indirect Vision. Y. le Grand and E. Geblewicz. *Comptes Rendus,* 205. *pp.* 297–298, *July* 26, 1937.—The authors observed that, when a flickering patch of light 8° in dia. is viewed by indirect vision so that its centre appears 15° on the nasal side of the fixation point, the sensation of flicker ceases after a certain time t which varies with the frequency of alternation N of the flickering field. Measurements at patch brightnesses of 620 and $3 \cdot 2$ c./m^2. (natural pupil) revealed that the product Nt was approximately constant for an extended range of frequencies N. In this range the flicker sensation ceases after a certain *total* number of alternations, equal to 330 and 160 respectively for the high and low brightnesses studied. With a coloured flickering light, the saturation of the colour appears to diminish rapidly and all colours appear finally to match a steady light having a colour temperature of about 5300° Abs. and placed just above the flickering light. It is tentatively suggested that in the final state pure rod vision is operative. W. S. S.

4573. Effect of Mountain Ascents and Wind on Adaptation in Peripheral Vision. P. Lasareff. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 16. 1. *pp.* 45–48, 1937. *In French.*—The author has previously found that variations occur in the maximum sensitivity of peripheral vision with the season, the time of day and the latitude of the place of observation and has shown that these can be explained as due to a temperature effect. Recent observations show that on mountains a greater visual sensitivity is obtained and for the particular case examined in this paper the observed change agrees approximately with that to be expected from the drop in temperature in ascending the mountain. Still better agreement is obtained by allowing for the pressure change which laboratory measurements show to have a similar effect. The action of the wind is also found to modify visual sensitivity by cooling the human body. W. S. S.

4574. Estimation of Ametropia by the Coincidence Optometer. A. H. Briggs. *Phys. Soc., Proc.* 49. *pp.* 444–454; *Disc.*, 455, *Sept.* 1, 1937.—One hundred and ten cases of refractive error were examined by means of the Fincham coincidence optometer [see following Abstract] and seven had to be rejected as unsuitable. The results in the remaining one hundred and three cases were checked by refraction and subjective testing. The patients were unselected, and a wide range of refractive errors was involved. No cycloplegic was employed on any case. On the assumption of the correctness of the result obtained by retinoscopy and subjective testing the margin of error has been determined and is given. The results compare very favourably, as regards accuracy, with the results of retinoscopy by an expert (the patients' pupils being undilated). Possible sources of error are discussed. Special types of case are discussed: aphakia, amblyopia, and irregular astigmatism. The optometer provides a means of analysing cases of irregular astigmatism accurately. Cases unsuitable for examination by the optometer are, with certain exceptions, found to be cases unsuitable for refraction by retinoscopy without the use of a cycloplegic. The estimation of the corneal astigmatism by keratometry is found not to give an accurate measure of the total astigmatism of the eye as a whole. AUTHOR.

***4575. Coincidence Optometer. E. F. Fincham.** *Phys. Soc., Proc.* 49. *pp.* 456–468, *Sept.* 1, 1937.—The power of the required spectacle lens may be determined objectively by the ophthalmoscopic observation of the retinal image of a target, the position of which can be adjusted relative to an optometer lens to bring it to the conjugate of the retina. In the past the method has depended upon the observer's estimation of focus, or of parallax between the retinal image and the target which is in the field of the observing system, or of coincidence between the retinal image and an index line in the observing system. This paper describes the principle of an instrument in which the adjustments for both refraction measurement and meridian location of an astigmatic eye are made by a coincidence setting between two parts of the retinal image. By this means the sensitivity of the method is increased by more than 100%. [See following Abstract.] AUTHOR.

∗4576. Development of the Fincham Coincidence Optometer. R. E. Reason. *Phys. Soc., Proc.* 49. *pp.* 469–478, *Sept.* 1, 1937.—The optical and mechanical features of a commercial development of the Fincham optometer [see preceding Abstract] are described. The instrument permits direct measurement of the cylinder axis and of the refraction in different zones of the pupil and through 360°; it incorporates means for transferring the focus from the retina to the pupil to facilitate alignment, and a fixation system for arresting the subject's accommodation. AUTHOR.

X-RAYS.

4577. Electron Distribution in the Focal Spot of X-Ray Tubes. J. Dosse. *Arch. f. Elektrot.* 31. *pp.* 534–544, *Aug.* 10, 1937.—The current passing through an X-ray tube is limited by the condition that the antikathode must not be heated above a certain temperature. If a certain area of the antikathode is struck by a homogeneous beam of electrons the temperature in the middle will rise higher than near the edges; the output may thus be increased by using an electron beam which is more intense near the edge, giving a uniform temperature distribution over the whole area. In this way the power input can be raised by 4 to 17% according to the time during which the tube is working. An electron optical method for determining the distribution of electrons in the beam is developed and tested by comparing it with pinhole camera photographs. R. P.

4578. Twofold Compton Scattering. F. Bopp. *Ann. d. Physik,* 30. 1. *pp.* 35–71, *Sept.,* 1937.—Deals with the Compton scattering of radiation for two different geometrical arrangements. In both cases the scatterer of the radiation consists of a plain plate which is placed symmetrically to the directions of incident and observed radiation. The radiation obtained in this twofold Compton scattering is not monochromatic. The spectrum lies between two given limits which are determined solely by the hardness of the primary radiation and the direction of scattering. In one case the maximum intensity lies in the interior of the spectrum near the long wave-length limit; while in the other it lies at the short and long wave limits. The mean frequency lies in the first case below and in the second case above that of the singly scattered radiation. The spectra and total intensities have been determined for Pb and Al. The values obtained are much larger than were at first expected. By calculation from the total twofold scattering, curves similar to those obtained by Gentner [see Abstract 3590 (1936)] have been again obtained. G. O. B.

4579. Compton Effect with Helium as the Scatterer. J. W. M. DuMond and H. A. Kirkpatrick. *Phys. Rev.* 52. *pp.* 419–436, *Sept.* 1, 1937.—The K-radiation from a Mo target was scattered through almost 180° by He at 14 atmos. pressure. The experimental arrangement was such that radiation from anything but He could not reach the recording spectrograph. The scattered radiation was resolved into a spectrum by a Cauchois focusing curved crystal spectrograph. Recording was done on a curved photographic film by an exposure of 2059 hr. The structure and breadth of the modified line were obtained by a microphotometer and the results were found to be in excellent agreement with the theoretical predictions of DuMond's theory. An expected defect in the shift, caused by the momentum imparted to the whole mass of the atom in ejecting the recoil electron, is also verified. In addition it is claimed that verification is obtained of the explanation, given by DuMond, of the excess breadth of the modified line when a solid scatterer is used. The experimental side of the investigation is fully dealt with both in the method of obtaining and correcting the results and also in the matter of the advantages and disadvantages of the types of crystal spectrographs. G. O. B.

4580. Shape of the Compton Line for Helium and Molecular Hydrogen. B. Hicks. *Phys. Rev.* 52. *pp.* 436–442, *Sept.* 1, 1937.—By using variation functions which take into consideration the instantaneous interaction of the electrons, momentum distribution functions and intensity distributions in the Compton line are computed for He and H_2, neglecting small relativity and binding corrections. The half-value breadths are expressed in terms of $l/2\lambda^*$ where l is the wave-length displacement from the centre of the shifted line and $2\lambda^* = (\lambda_1^2 + \lambda_s^2 - 2\lambda_1\lambda_s \cos\chi)^{\frac{1}{2}}$. λ_1 and λ_s are the primary and scattered wave-lengths and χ the scattering angle. The absolute breadth of the line may therefore be computed for any λ_1 and χ. For He and H_2 the values of $l/2\lambda^*$ at half-maximum are 10·8 and 8·5, respectively. AUTHOR.

4581. Variation of Atomic Structure Factor of Nickel with X-Ray Wave-Length. W. P. Jesse. *Phys. Rev.* 52. *pp.* 443–451, *Sept.* 1, 1937.—X-ray measurements have been made with a vacuum ionisation spectrometer on powdered Ni to determine the variation of the atomic structure factor in the region of the K absorption edge, 1·4839 Å, and as far out as possible on the long wave-length side. Powdered NaCl and LiF have been used as comparison substances. Extensive measurements over a range of wave-lengths from 0·560 to 2·74 Å have been made. *Conclusions:* The experimentally determined dispersion curve for the atomic structure factor of Ni, based upon the difference between measured structure factor values on the long and short wave-length side of the K absorption edge, does not agree in shape with the theoretical curve of Hönl. The experimental curve rises more rapidly from the absorption edge and is then flatter than the theoretical curve. The two curves come into closer agreement at longer wave-lengths. The maximum discrepancy between theory and experiment is about 0·9 electron at $\lambda/\lambda_K = 1{\cdot}11$. The predicted invariance of the structure factor decrement due to K electrons with $(\sin\theta)/\lambda$ is again confirmed. [See also Abstract 2360 (1936).] AUTHOR.

4582. Fourier Analysis of X-Ray Scattering from Polyatomic Liquids. W. C. Pierce. *J. Chem. Phys.* 5. *pp.* 717–720, *Sept.*, 1937.—It is shown that the Fourier integral analysis of X-ray scattering for liquids with polyatomic molecules containing like atoms may be simplified if the X-ray diffraction curve is corrected by subtraction of the gas scattering of the single molecules before the analysis is made. The method is tested by an analysis of Katzoff's data for benzene. The distribution function obtained indicates that a given molecule is surrounded by six neighbours in the plane of the benzene ring, with a mean separation of centres of about 6·7 Å. The neighbours of a given molecule are oriented with respect to the molecule. The parallel planes of flat molecules are separated by a distance of 3·7 Å. The structure is very similar to the crystal structure of hexamethyl benzene. AUTHOR.

4583. Origin of Satellites of X-Ray Lines. L. Pincherle. *N. Cimento*, **14.** *pp.* 185–195, *April*, 1937.—There are two possible explanations for the satellites. The first attributes them to atoms which have lost one or more electrons besides the missing electron from an inner shell which is responsible for the transition. The second explanation attributes them to transitions in which two electrons jump simultaneously. It is shown that both these effects exist in principle, but that the second is in practice always so small that the lines due to it should be undetectable. R. P.

4584. K-Emission Spectra of Ga (31) and Ge (32). H. Hulubei. *Comptes Rendus*, 205. *pp.* 440–442, *Aug.* 30, 1937.—The K-spectra of Ga and Ge are studied with a curved quartz crystal spectrograph giving a dispersion of 5X.U./mm. As reference lines the strong lines of these elements, the K lines of As and the L lines of W and Rh are used. The spectra of both elements are of great complexity. A number of α non-diagram lines, some previously observed and some new lines, are measured. Two new lines are designated $K\alpha_{I}$ and $K\alpha_{II}$. In the β series the $KM_{II,\ III}$ doublet has been partially resolved for both elements, while the intense $KM_{IV,\ V}$ (β_5) line now appears totally separated from $KN_{II,\ III}$ (β_2) not only for Ge but also for Ga. A number of β non-diagram lines are recorded. The plates show also a number of weak lines which are difficult to measure. C. J. B. C.

4585. Thickness of Silver Chloride Film on a Silver Plate. S. Shimadzu. *Kyoto Coll. Sci., Mem.* 19. *pp.* 229–236, *Sept.*, 1936. *In English.*—A powder X-ray photograph taken of a silver plate coated with AgCl film which is produced by dipping the plate into chlorine water, contains Debye-Scherrer rings of Ag and AgCl. The thickness of the film can be measured by comparing the intensities of the rings of both substances. AUTHOR.

4586. Intensity of X-Ray Reflections. A. Baxter and J. C. M. Brentano. *Phil. Mag.* 24. *pp.* 473–492, *Sept.*, 1937.—The work described refers to intensities as determined from powder photographs, but with little modification could be applied to ionisation-chamber methods. Grave errors in the photometric estimation of the intensity of X-ray lines can be introduced by an ignorance of abrupt variations in the intensity of the general background. These variations arise from two causes—absorption steps caused by absorption in the anti-kathode itself, and sudden sensitivity changes of the photographic emulsion for certain wave-lengths. The error is less for sharp, well-focussed lines. A substitution method in which reflections from different substances are recorded separately and the crowding of the lines and background steps is thus reduced, is compared with the method of mixed powders. Owing to unsatisfactory data for absorption coefficients, the former method is useful only for qualitative comparisons of lines. Another method of eliminating background errors by use of compensating filters is discussed, and a technique is advocated for deriving intensity data from specially selected lines instead of from the average of a large number of lines. G. G.

See also Abstracts 4311, 4456, 4474, 4649, 4656.

HEAT.

CALORIMETRY.

4587. Lattice Energy of Solid CO_2. H. Sponer and M. Bruch-Willstätter. *J. Chem. Phys.* 5. *pp.* 745–751, *Sept.*, 1937.—It is possible to account for the measured sublimation heat of solid CO_2 by calculating the attraction energy according to London's theory of van der Waals forces; or, when the second approximation of the attractive forces is included, by considering also the electrostatic energy due to the dipole moments and the repulsive energy, the latter being deduced from the equilibrium condition. For the calculation of the electrostatic energy the picture of point charges with definite distances seems preferable to that of short dipoles. AUTHOR.

See also Abstracts 4533, 4599, 4603, 4625, 4649.

CONDUCTION.

4588. Two-Dimensional Problems in Heat Conduction. A. N. Lowan. *Phil. Mag.* 24. *pp.* 410–424, *Sept.*, 1937.—This paper is an extension of previous work [see Abstract 3645 (1937)] on unidimensional heat flow to the case of two-dimensional cases. The problem here investigated is that of heat conduction in an infinite parallelepiped bounded by the planes $x = 0$, $x = a$, $y = 0$, $y = b$, the latter faces being impervious to heat, and the other two faces being subject to a generalised surface condition. The problem is solved by using the Laplace operator and Borel's theorem. E. H. D.

4589. Pressure Dependence of Thermal Conductivity of Gases and Vapours. N. Vargaftik. *Techn. Phys., U.S.S.R.* 4. 5. *pp.* 341–360, 1937. *In English.*—The hot-wire method is applied to the determination of the thermal conductivity of gases and vapours in dependence on the pressure. Tubes of very small diameter (less than 1 mm.) were used. Measurements are made of the thermal conductivity of N_2 up to 90 atmos. and steam up to 30 atmos. It is shown that in these pressure regions no convective transmission of heat occurs in the apparatus. The dependence of the coefficients of thermal conductivity of nitrogen and steam on the pressure is found. A comparison is made between the experimental results for the thermal conductivity and those found from the relationship $\lambda = KC_v\eta$. AUTHOR.

4590. Convection in Liquid Thermal Conduction Determinations. P. Vernotte. *Comptes Rendus*, 205. *pp.* 411–413, *Aug.* 23, 1937. In an earlier paper [see Abstract 281 (1937)] the possibility is considered of a pre-convective state in which, for very small temperature differences, heat is transferred upwards through a horizontal liquid layer by pure conduction. It is now shown that in the case of a heated body immersed in a liquid the smallest flux of heat promotes convection. The usual arrangement for the measurement of conductivity is then considered in which the upper surface of the liquid layer is heated, and, for the prevention of convection, it is shown that extreme care must be taken to maintain the upper and lower surfaces truly isothermal. Convection will also result if a body of different conductivity, and of sufficient size to distort the flow lines, is immersed in the liquid. R. W. P.

***4591. Micro-Thermal Conductivity Gauges. J. L. Bolland and H. W. Melville.** *Faraday Soc., Trans.* 33. *pp.* 1316–1329, *Sept.*, 1937.—Improvements in the design of small volume thermal conductivity cells, suitable for the micro-analysis of gas mixtures are described. The volume of the cells may be reduced to 0·05 c.c., thus permitting the analysis of 0·005 c.c. (at N.T.P.) of binary mixtures, the constituents of which possess different thermal conductivities. A theory has been developed to account for the behaviour of the gauges when filled with H_2, D_2, $H_2 - D_2$, and $H_2 - HD - D_2$ mixtures. As a result conditions have been defined so that a gauge will or will not discriminate between equilibrated and non-equilibrated $H_2 - D_2$ mixtures. The optimum conditions for the analysis of *ortho-para* H_2 mixtures has also been worked out. By making use of the variation of rotational specific heats of $H_2 + D_2$ with temperature, a method is described for the analysis of ternary mixtures containing H_2, D_2 and a third constituent, non-condensable in liquid air, such as CO, CH_4, O_2, N_2 and the inert gases. The method is also applicable to any ternary mixture having H_2 as one constituent provided that the thermal conductivities of the other two constituents are different. [See following Abstract]. AUTHOR.

***4592. Estimation of Hydrogen Deuteride by Micro-Thermal Conductivity Gauge. G. H. Twigg.** *Faraday Soc., Trans.* 33. *pp.* 1329–1333, *Sept.*, 1937.—A high-pressure micro-thermal conductivity method is described for the estimation of HD molecules in mixtures of $H_2 + D_2$. The composition calibration curve is not linear as would be expected from the theory of the gauge. [See preceding Abstract]. AUTHOR.

See also Abstract **4418.**

CONVECTION.

See Abstract **4590.**

DILATATION.

See Abstracts **4290, 4314.**

MELTING AND BOILING POINTS.

4593. Superheating of Liquids. W. Döring. *Zeits. f. phys. Chem.* 36. *Abt.B.* 5–6. *pp.* 371–386, 1937.—The whole question of superheating is considered theoretically. The formation of bubbles or possible sources of bubbles is considered. It is shown that there is a limit to the attainable amount of superheating, and the calculated value of this limit is in good agreement with the experimental values of Wismer. E. H. D.

4594. Physicochemical Constants of Benzene. M. Wojciechowski. *Bureau of Standards, J. of Research,* 19. *pp.* 347–352, *Sept.*, 1937.—A series of preparations of benzene of a high degree of purity were made by fractional distillation, by azeotropic distillation with ethanol, and by crystallisation followed by centrifuging. The following physicochemical constants were measured: boiling point, 80·094 ± 0·002° C; freezing point, 5·51 ± 0·01° C; refractive index n_D^{25}, 1·49807 ± 0·00006; and density at 25° C, 0·87366 gm./cm³. ± 0·00002. Previous determinations of these constants, as reported in the literature, are reviewed. AUTHOR.

4595. Intensity of Orbital Interaction in Crystals. R. Forrer. *J. de Physique et le Radium,* 8. *pp.* 241–250, *June*, 1937.—This is an attempt to connect the intensity of the orbital contacts, $F = T/N^{\frac{1}{2}}$ [see Abstract 2170 (1937)] with the atomic number and electronic structure of the constituent elements. C. A. S.

4596. Glass-State and Artificial Resins. E. Jenckel. *Naturwiss.* 25. *pp.* 497–500, *July* 30, 1937.—A discussion of the nature of the transformation interval of the artificial resins, leading to the conclusions that these resins, or at least those that soften by heat, are to be regarded as in the glassy state; that the transformation interval is a "freezing-in (*einfrier*) temperature." It should therefore be possible to modify their physical properties by varying the rate of cooling. Lastly the increase in strength resulting from slight deformation resembles the strengthening of metals by cold-working. C. A. S.

4597. Drop Formation at Ions in Supersaturated Vapours. T. Glosios. *Kolloid Zeits.* 80. *pp.* 269–273, *Sept.*, 1937.—Condensation at ions in supersaturated vapours has been theoretically and experimentally investigated. By means of a simple kinetic proposition it has been found possible to establish theoretically the number of nuclei (or drops) which arise per second, and this hypothesis has been tested experimentally in two different ways *viz.* (1) By the dependence of the critical supersaturation on the current ionic intensity, and (2) by the dependence of the number of drops on the degree of expansion at constant ionic intensity. Full experimental details with diagram are included. H. H. Ho.

***4598. Electric Heater for a Water Still. F. R. Pratt.** *Rev. Sci. Instruments*, 8. *pp.* 286–287, *Aug.*, 1937.—An electric heater, for a multiple still [see Abstract 3253 (1936)], is described which uses, instead of resistance coils, the water to be heated as the resistance element. The electrodes are adjustable carbon rods. Full constructional details are given. The heater has the following advantages; (1) no coil to burn out, (2) the heater does not become coated from use of hard water, (3) no damage is done if the current is turned on when the boiler is empty, (4) if the water supply fails the heater operates until the boiler is almost empty and then the current ceases to flow, and when the supply is restored the heater again operates, (5) all energy supplied enters the water. C. J. B. C.

See also Abstracts 4235, 4367, 4425.

THERMOCHEMISTRY.

***4599. Calorimetric Test of the Solubility Equation for Regular Solutions. R. D. Vold.** *Am. Chem. Soc., J.* 59. *pp.* 1515–1521, *Aug.*, 1937.—A calorimeter is described for the measurement of heat capacities and of heats of mixing of corrosive liquids which must be kept in a closed system to avoid decomposition. The experimental data obtained include heat capacities and heats of formation of solutions of $CCl_4 - SiCl_4$, $CCl_4 - C_6H_6$, $CCl_4 - n$-heptane, $C_6H_6 - n$-heptane, and heat capacities of solutions of $SnCl_4$ and CCl_4 and of all the pure liquids, all at 25°. The heats of mixing are used to test the validity of an equation for the molal change in heat content on mixing two liquids. N. M. B.

4600. Lattice Disturbances, Particle Sizes and Thermal Content of Pyrophoric Iron. R. Fricke, O. Lohrmann and W. Wolf. *Zeits. f. phys. Chem.* 37. *Abt.B.* 1–2. *pp.* 60–74, 1937.—This paper is the 20th communication respecting the structure, thermal content and special properties of active substances. It has been found that the reduction of röntgenographic amorphous iron III-oxyhydrate with H_2 afforded pyrophoric iron at 350°, but iron which was no longer pyrophoric at 640°. The heat of solution of both varieties of iron was determined under comparable conditions whereby the thermal content of the pyrophoric iron was found to be about 1·4 k.cal./gm. atom greater than that of the inactive form. Both kinds of iron were investigated röntgenographically for the causes of the observed differences in thermal content. The evaluation from the intensity data of the lattice disturbances afforded an average deviation of the iron atom from the normal position of 0·06 Å for pyrophoric iron. A lattice disturbance could not be established for the inactive iron. The calculated difference in thermal content from the lattice disturbance is > 0·85 k.cal. and in dimensional agreement with the calorimetric value. H. H. Ho.

4601. Heats of Combustion of Ethylene and Propylene. F. D. Rossini and J. W. Knowlton. *Bureau of Standards, J. of Research,* 19. *pp.* 249–262, *Sept.,* 1937.—The data of the present investigation give for the heats evolved in the combustion of gaseous ethylene and propylene in oxygen, at 25° C. and a constant pressure of 1 atmos., to form gaseous CO_2 and liquid water, the following values in international kilojoules per mole: ethylene, 1410·97 ± 0·30; propylene, 2057·42 ± 0·62. Converted to k.cal. by means of the factor 1/4·1833, these values become, respectively, 337·28 ± 0·07 and 491·82 ± 0·15 k.cal./mol. A review of the existing data indicates that the hitherto " best " values for the heats of combustion of these gases differ from the values obtained in the present investigation by − 1·6% for ethylene and − 0·4% for propylene. These differences are, respectively, about 75 and 12 times the estimated uncertainties in the new values. AUTHORS.

4602. Heats of Combustion and of Formation of the Normal Olefin (Alkene-1) Hydrocarbons in the Gaseous State. F. D. Rossini and J. W. Knowlton. *Bureau of Standards, J. of Research,* 19. *pp.* 339–345, *Sept.,* 1937.—The existing thermochemical data on the normal olefin (alkene-1) hydrocarbons are reviewed and correlated. These data are used in conjunction with the value previously proposed for the increase in the heat content per added CH_2 group to obtain values for those members of this series of hydrocarbons for which no calorimetric data exist. For all these hydrocarbons in the gaseous state, selected " best " values are given for the heats of combustion at 25° C. and for the heats of formation, from solid C and gaseous H_2, at 25° C. and 0° K. As in the case of the previously reported values for the normal paraffin hydrocarbons and primary normal alkyl alcohols, the heats of formation of the gaseous normal olefin (alkene-1) hydrocarbons can be represented by means of an expression of the form $\Delta H = A + Bn + \Delta$, where ΔH is the heat of formation, A and B are constant for a given temperature, n is the number of C atoms in the molecule C_nH_{2n}, and Δ is the term giving the deviation from linearity, which is zero for $n > 5$. Values of the constants A and B and of Δ are given both for 25° C. and 0° K. AUTHORS.

4603. Heats of Reaction and Specific Heats of Aniline—*o*-Chlorophenol Mixtures: and a Test of Macleod's Viscosity Equation. C. D. Ellyett. *Faraday Soc., Trans.* 33. *pp.* 1218–1224, *Sept.,* 1937.—Heats of reaction and specific heats are measured for aniline —*o*-chlorophenol mixtures at 25°, 35°, and 78° C. The percentages of compound formation, calculated by means of the law of mass action, are compared with the values obtained by Macleod from his viscosity formula, agreement being obtained at higher temperatures. An account is given of the disturbing factors at lower temperatures. No support is obtained for Macleod's theory of increasing heat of reaction with temperature. AUTHOR.

4604. Thermal Data of Copper Sulphate Hydrates and Deuterates. E. Lange and H. Sattler. *Zeits. f. phys. Chem.* 179. *Abt.A.* 6. *pp.* 427–444, 1937.—Measurements have been made of the isotope effect in heats of formation and of solution in H_2O and D_2O of $CuSO_4$ and its mono-, tri- and pentahydrates. The thermal data for these reactions are given both in tabular and graphical form. The forces of attraction between the ions and the water molecules are discussed and two methods are suggested by which these forces can be calculated from the heats of formation and of solution of the hydrates. The isotope effect was also found to exist in the forces of attraction between the ions and the molecules of H_2O or D_2O, and this leads to the conclusion that the D_2O molecules are bound more closely to the ions than are the H_2O molecules. G. G.

***4605. Heats of Formation of Alloys. W. Seith and O. Kubaschewski.** *Zeits. f. Elektrochem.* 43. *pp.* 743–749, *Sept.*, 1937.—The heats of formation of the systems: Pb-Mg, Pb-Na, Pb-Li, Bi-Mg, Bi-Na, Bi-Li and Cd-Na have been measured at room-temperature and the heats of formation of the systems Pb-Mg and Bi-Mg at 860°. The special form of apparatus employed is described in detail and the paper is replete with data and explanatory diagrams. H. H. Ho.

4606. Low-Temperature Transformation. A. Debierne and L. Goldstein. *Comptes Rendus,* 205. *pp.* 321–322, *Aug.* 2, *and p.* 368, *Aug.* 9, 1937.—The heat evolution that occurs [see Abstract 4114 (1937)] when small quantities of He or H come in contact with other solids that have been deprived of occluded gas by heating in a vacuum and subsequent cooling at the temperature of liquid N, was examined. He and Be show an even greater heat evolution than He and C, H and Be and He and Mg show a considerable evolution, He and Al somewhat less, He and Ni still less, while He and Cu and He and sand show probably none at all. C. A. S.

See also Abstract 4587.

THERMODYNAMICS.

4607. Chemical Theory of Gases. Part III. J. Duclaux. *J. de Physique et le Radium,* 8. *pp.* 277–280, *July,* 1937.—The author's previously suggested theory [see Abstract 3154 (1927)] that the excess of compressibility of a real gas with respect to an ideal gas is attributable to the formation of double molecules, is found to receive further evidence from the study of many properties of O_2 and of NO such as the magnetic behaviour, luminous absorption, and chemical reactivity. By calculating the number of double molecules from the data obtained from the various phenomena above, the results are found to be always of the same order of magnitude as those based on the compressibility data, and in some cases are identical. It follows from these results that any theory of the compressibility of gases should take into account the presence of double molecules or pairs of molecules, thus facilitating the correlation of gaseous properties. H. H. Ho.

4608. Liquid State. Part II. M. Surdin. *J. de Physique et le Radium,* 8. *pp.* 294–308, *July,* 1937.—In continuation of earlier work [see Abstract 297 (1937)] it is shown that the law of corresponding temperatures can be applied with a considerable degree of approximation to the properties of liquids under their saturation pressures. For each of the static properties of liquids a unique curve is obtained, which is independent of the liquid, when data are plotted for a reduced temperature, fixed in accordance with van der Waals' equation as $\theta_w = T_l/T_c = 0{\cdot}6$. More generally, by adopting for the reduced temperature the expression $\theta = (T - T_0)/(T_c - T_0)$, T_c being the critical temperature, and T_0 an arbitrary temperature less than T_m, the coincidence between the curves v/v_0, etc., holds good to an extent depending on T_m. R. W. P.

4609. Persistence of the Liquid State of Aggregation above the Critical Temperature. O. Maass and A. L. Geddes. *Roy. Soc., Phil. Trans.* 236*A*. *pp*. 303–332, *July* 7, 1937.—The work arose out of the fact that the rate of reaction of a liquid mixture has been found to increase with rise in tenperature in the usual manner up to the critical temperature, but was nil in the absence of the liquid phase, in experiments on mixtures of propylene and HCl. It was decided to investigate any discontinuity of state existing at the critical temperature in a two-component system, it being usually supposed that the change is continuous in a one-component system. One-component systems have first been investigated and it has been shown that when a liquid is heated above its critical temperature a difference in density persists above and below the position where the meniscus is last seen. Previous work in this direction is described and then the work on ethylene is described in detail. The apparatus was specially designed so that any one of the three variables P, V and T could be maintained constant while the other two were varied. The significance of the results is discussed and a tentative explanation is put forward. E. H. D.

4610. Theory of the λ-Point of Helium. H. Fröhlich. *Physica,* 8. *pp.* 639–644, *Aug.*, 1937. *In German.*—The theories of London are discussed in some detail together with others [see Abstract 770 (1936)]. It is suggested that at absolute zero He has a diamond structure, and the λ-point is to be regarded as similar to the transformation point of metallic alloys when the change from an ordered to a disordered state occurs. E. H. D.

4611. Isotherms and Isobars of N_2–CO System. N. Torocheshnikov. *Techn. Phys., U.S.S.R.* 4. 5. *pp.* 365–369, 1937. *In English.*—Data for the liquid-vapour equilibrium in the N_2–CO system for a series of integral values of temperature and pressure are presented. From the equation: $\log f = \log (P - 0{\cdot}0106P^2) - (2{\cdot}16P + 0{\cdot}0262P^2)(1/T - 0{\cdot}008)$ the necessary data for the equilibrium in the N_2–CO system can be calculated. The data obtained may be used in the design of apparatus for the separation of coke-oven gas by liquefaction, where the fraction $CO + N_2$ is formed. AUTHOR.

4612. Statistical Theory of Perfect Solutions. R. H. Fowler and G. S. Rushbrooke. *Faraday Soc., Trans.* 33. *pp.* 1272–1294, *Sept.*, 1937.—The statistical theory of perfect solutions discussed by Guggenheim [see Abstract 1214 (1935)], is extended to liquid mixtures in which the molecules are unequal in size. The approximation used for studying the combinatory factor is to reduce the liquid arrangements to those of a simple regular lattice and to represent a change of size by making one molecule twice the size of the other and assigning it two adjacent lattice points. The calculations thus apply strictly only to a crystalline solid and only by inference to a liquid mixture; the error in this approximation is unknown. Non-linear partial vapour density curves of a binary liquid mixture may be due to the components differing widely in molecular size and are not necessarily due to intermolecular forces except in so far as these forces determine the structure of the liquid. J. S. G. T.

4613. Thermodynamics of Gaseous Hydrocarbons. K. S. Pitzer. *J. Chem. Phys.* 5. *p.* 752, *Sept.*, 1937.—A correction. [See Abstract 3191 (1937).]

4614. Thermodynamic Conditions and Efficiencies of the Coupling of Chemical Reactions. P. van Rysselberghe. *J. Phys. Chem.* 41. *pp.* 787–796, *June,* 1937.—Thermodynamic properties of systems in which simultaneous reactions are taking place are briefly reviewed. The thermodynamic conditions for the coupling of a reaction with negative affinity by a reaction with positive affinity are established. Rules are proposed for the choice of independent reactions in the case of biological systems. The machine efficiency (Burk), or preferably thermodynamic efficiency, is formulated. The stoichiometric condition for the coupling (Burk) is expressed in simple mathematical form. The second-law efficiency (Burk), or preferably stoichiometric efficiency, is formulated. AUTHOR.

4615. Energy Hump in Chemistry. Part I. W. D. Bancroft and J. E. Magoffin. *Frank. Inst., J.* 224. *pp.* 283–309, *Sept.,* 1937.—A system has to pass an energy hump for a reaction to take place, when the reaction is permitted by the free energy relations, but cannot take place until some molecules of the reactants are raised to an energy level higher than that attained by any molecule of the reactants under ordinary conditions. The concept of the energy hump is a normal extension of the concept of the energy of activation, and includes it as a special case. The height of the energy hump is defined as the difference between the free energy of the system and the necessary voltage energy to produce the reaction, for those cases where the reaction can be made to take place electrolytically. The energy hump tends to disappear with increasing concentration or rise of temperature, as is shown in the case of H_2SO_4 solution. The energy hump may be eliminated by a suitable catalytic agent, as is the case with osmic acid and $KClO_3$, or in the case of Pt and H_2. F. J. B.

4616. Thermodynamics of Irreversible Processes. Parts II and III. A. R. Ubbelohde. *Faraday Soc., Trans.* 33. *pp.* 1198–1212, *Sept.,* 1937.—Part II of this paper deals with the velocity of chemical reaction. An irreversible change takes place in a system, which is in equilibrium with respect to temperature and pressure, as a result of local fluctuations of sufficient magnitude. If these fluctuations are independent, the velocity constant can be expressed in terms of the equilibrium constant, which in turn can be expressed in the thermodynamic variables of the system in the usual way. When they are not independent, wall effects and a variation of velocity with pressure are to be expected, as are observed in chain reactions. In Part III these ideas are applied to the velocity of irreversible changes of structure in solids. In the case of the solid–liquid transition, supercooling, superheating, and the law of successive states are explained by an expression for the probability of the necessary fluctuations. Hysteresis is discussed and it is shown that it must exist for all spontaneous changes in such systems; examples are to be found in ferromagnetism, the formation of the β-phase from the α-phase in palladium hydride. The problem of supraconductivity is also considered and an explanation is attempted on the grounds that some other form of energy becomes available below the transition point. [For Part I see Abstract 2723 (1937).] G. G.

See also Abstracts 4231, 4282, 4377, 4593, 4675, 4676.

VAPOUR PRESSURE.

See Abstract 4347.

ACOUSTICS.

4617. Production of Chladni Figures with Solid Carbon Dioxide. Part I. Bars and Other Metal Bodies. Mary D. Waller. *Phys. Soc., Proc.* 49. *pp.* 522–530; *Disc.*, 530–531, *Sept.* 1, 1937.—Chladni figures can be very readily produced by means of solid CO_2: some photographs of results obtained on metal objects of various shapes are shown. The frequencies of the vibrations excited in objects of low fundamental tone usually lie between about 1000 and 4000. The theoretical implications of this fact are considered. AUTHOR.

4618. Sound-Field Due to a Vibrating Piston. L. Gutin. *Techn. Phys., U.S.S.R.* 4. 5. *pp.* 404–413, 1937. *In German.*—The sound-field due to a piston oscillating in an infinite baffle is calculated and the directional characteristics determined. By combining the result with that applicable to a pair of pistons vibrating in opposite phases, the sound-field due to a piston which radiates from one face only is calculated. This result is then used to study the acoustical characteristics of an exponential horn. Good agreement with experiment is obtained for the radiation factor of an exponential horn. The amplification factor of a horn used to collect sound is calculated, the special case in which the end of the horn is closed with a membrane being also considered.

J. E. R. C.

4619. End-Correction of an Unflanged Pipe. A. E. Bate. *Phil. Mag.* 24. *pp.* 453–458, *Sept.*, 1937.—The conductivity of a conducting disc embedded in an infinite medium of specific conductivity k is equal to $8kr$, r being the radius of the disc. This is shown to become $4kr\sqrt{2}$ when one face is insulated, and when applied to the question of the effect of the removal of a flange on the end-correction of a flange pipe it is shown that the correction is diminished to $(0\cdot5)^{\frac{1}{2}}$ of its former value, *i.e.* from $0\cdot82r$ to $0\cdot58r$. [See also Abstract 782 (1936).] AUTHOR.

4620. Vortex Motion Causing Edge Tones. G. B. Brown. *Phys. Soc., Proc.* 49. *pp.* 493–507, *Sept.* 1, 1937.—A detailed investigation of the tones produced when a jet of air strikes an edge, with velocities extending from the lowest possible to those in the neighbourhood of the Reynolds critical velocity in the orifice. Four different stages of stable vortex-formation occurred and the whole phenomenon is found to lie within the sound-sensitive range of the jet. Throughout this range the dependence of the frequency n on the distance h of the edge and the mean velocity U can be closely represented for a 1-mm. slit-width and a wedge of angle 20° by the formula $n = 0\cdot466\ j\ (\mathrm{U} - 40)\ (1/h - 0\cdot07)$, where $j = 1,\ 2\cdot3,\ 3\cdot8$ and $5\cdot4$ for the four stages respectively. The stage represented by $j = 1$ may occur simultaneously with the other stages and thus two notes of different pitch may be produced. Comparison with the vortex motion in sensitive jets shows marked similarity, but it cannot be assumed that the vortex motion in edge tones has its origin at the orifice, as it always has in sensitive jets. [See following Abstract.]

AUTHOR.

4621. Mechanism of Edge-Tone Production. G. B. Brown. *Phys. Soc., Proc.* 49. *pp.* 508–521, *Sept.* 1, 1937.—Former theories of the production of edge tones are reviewed and a new theory is put forward which accounts in a qualitative manner for the phenomena described earlier [see preceding Abstract]. The effect of the wake of a disturbance on the portion of the jet immediately following it is considered, and it is concluded that the compressibility and structure of the surrounding medium must be taken into account, and that, for low velocities, wake disturbance is the controlling factor, whilst for higher velocities the effect of the sound emitted must be taken into account. An attempt is made also to account for the differential sensitivity to frequency found in sensitive jets in a former research. [See Abstract 3123 (1935).] AUTHOR.

4622. Theory of Violin String. A. Witt. *Techn. Phys., U.S.S.R.* 4. 4. *pp.* 261–288, 1937. *In French.*—A detailed theoretical study of the vibration of the violin string. Specially to be noted are the establishment of sub-harmonic and relaxation oscillations and the analogies with Lecher wire phenomena. W. H. G.

4623. Violin Intonation. P. C. Greene. *Acoustical Soc. of America, J.* 9. *pp.* 43–44, *July,* 1937.—Eleven unaccompanied performances by six professional violinists were recorded by the aid of an oscillograph. It was found that the six violinists typically performed in neither the natural nor the equally tempered scale. All players agreed exactly as to the *direction* of typical deviation from the equally tempered interval values, with minor variations as to the extent of deviation. As compared with both natural and equally tempered intonation, major seconds and major thirds tended to be expanded, minor seconds and minor thirds, to be contracted, and perfect fourths to be unaltered. W. H. G.

4624. Accuracy of Pianoforte Tuning. W. B. White. *Acoustical Soc. of America, J.* 9. *pp.* 47–50, *July,* 1937.—A description of a systematic method of tuning to equal temperament, based upon beat-rates. The tuning is by fifths and fourths and the testing by sixths and thirds. W. H. G.

4625. Excitation of Intramolecular Vibrations in Gases and Gas Mixtures by Collisions. Part IV. A. Eucken and E. Nümann. *Zeits. f. phys. Chem.* 36. *Abt.B.* 3. *pp.* 163–183, 1937.—Measurements of the dispersion and absorption of sound were made in pure CO_2 and N_2O at temperatures up to 400° C. In these substances, and also when He and H_2O are added to them, the valency vibrations are excited as easily as the deformation vibrations. It is supposed that this effect is not due to simple equality of sensitiveness to impact, but to a very rapid adjustment of equilibrium of the energy in the two forms of vibration. In CO_2 the mean number of collisions passes through a minimum value as the temperature rises, whereas in N_2O there is a continuous increase in this number. An explanation of this is suggested. [For Part III see Abstract 5129 (1935).] G. E. A.

4626. Supersonics. W. Mayberry. *Electronics,* 10. *pp.* 7–9, *July,* 1937.—For the experimental purposes described the frequency may exceed the maximum (50 kc./sec.) practicable for underwater signalling. The wave patterns on vibrating quartz are explained. The physical effects described include: (1) heating of media by absorption of the waves; (2) movement of particles into nodes; (3) flocculation; (4) dispersion at interfaces; (5) cavitation (expulsion of dissolved vapours); (6) compression and rarefaction of the media (up to ± 20 atmos.); (7) acceleration of chemical actions. Biological effects are also reviewed. R. M.

V. 19

4627. Frequency and Temperature Effect on the Velocity of Supersonic Waves in Gases. G. W. Warner. *Acoustical Soc. of America, J.* 9. *pp.* 30–36, *July,* 1937.—An experimental study in which a modified Kundt's tube with movable reflector is used for producing standing waves. As the reflector is moved it passes through nodes and loops and the varying amount of energy reabsorbed by the electrical circuit is used to determine the wave-length of the reaction of a r.f. milliammeter in the energising circuit. In CO_2, N_2O and SO_2 the velocity increases with increasing frequency but the increase is greater in CO_2 than in the other two gases. The velocity at any frequency is practically constant at all temperatures in N_2O and SO_2, but in CO_2 the curve is flat for the lower temperatures, decreases rapidly by from 6–10 m./sec. in the temperature range from 60° to 130° C, and again becomes constant at the higher temperatures. W. H. G.

4628. Velocity and Absorption of Sound at Ordinary and Low Temperatures. A. van Itterbeek and P. Mariëns. *Physica,* 4. *pp.* 609–616, *Aug.,* 1937. *In English.*—Measurements of the absorption and velocity of sound in O_2, H_2 and CO have been made as a function of pressure and temperature. The relaxation time for O_2 is calculated and found to vary inversely as the pressure at a temperature of about 13° C. A departure from this law occurs at higher temperatures; at low temperatures, the absorption coefficients are higher than those predicted by the classical formula. As in earlier measurements [see Abstract 1755 (1937)], absorption in H_2 is found to be very high. The absorption in this gas is unaffected by increasing the concentration of para-hydrogen. Measurements made in CO, for which the vibrational energy is small at ordinary temperatures, also show deviations from the classical formula. J. E. R. C.

4629. Influence of Supersonic Vibrations on Electrolytic Separation Potential of Gases. G. Schmid and L. Ehret. *Zeits. f. Elektrochem.* 43. *pp.* 597–607; *Disc.,* 607–608, *Aug.,* 1937.—The kathodic separation potential of H can be changed by supersonics. The effect with high intensity is depolarising. This paper deals with this depolarising action on the kathodic H separation and with the rise in depolarisation which occurs with increasing intensity of sound. The height of this rise, was somewhat independent of the metal of the kathode, and of the current density when neutral $0{\cdot}4N$ Na_2SO_4 solution was used and amounted to about 800 mV. With increasing current density the rise became slight and at current densities of over 10 mA/cm², could no longer be fully observed. J. J. S.

4630. Light Diffracted by Supersonic Waves in Solids. H. Mueller. *Phys. Rev.* 52. *pp.* 223–229, *Aug.* 1, 1937.—The intensity and polarisation of the light diffracted by supersonic waves in solids are calculated by considering the photoelastic effect due to the strains created by the elastic waves. For natural incident light the diffracted light is partially polarised. In glasses and cubic crystals the diffracted light is partially depolarised if the incident light is polarised. The intensities are evaluated with the help of the theory of Raman and Nath and it is shown that this theory explains the measurements better than Brillouin's approximation. The calculated intensity distributions for natural and polarised incident light agree with the observations of Schaefer and Bergmann on glasses, quartz and calcite. This agreement justifies Fues' and Ludloff's assumption that all forced vibrations of the same frequency oscillate with the same amplitude. AUTHOR.

4631. Scattering of Light by Weak Supersonic Radiation. E. David. *Phys. Zeits.* 38. *pp.* 587–596, *Aug.* 1, 1937.—The first part of the paper is largely mathematical, being a calculation of the intensity of light scattered by weak supersonic radiation, the sound field being plane, homogeneous and sharply limited. In the second part of the paper the results obtained are described graphically. J. E. R. C.

4632. Transmission of Sound by Composite Partitions. C. J. Morreau. *Engineering*, 144. *p.* 192, *Aug.* 13, 1937.—An approximate method is given of calculating the sound transmission through a partition consisting of several areas of differing sound-reduction factors, and working rules for making this calculation are deduced. J. E. R. C.

***4633. Audiometer Specifications.** *Acoustical Soc. of America, J.* 9. *pp.* 72–73, *July*, 1937.—The paper presents for comment and criticism, specifications under nine headings drawn up by the Sub-Committee on Audiometry and Hearing Aids of the Sectional Committee on Acoustical Measurement and Terminology. W. H. G.

4634. Loudness and Masking Relationship. H. Fletcher and W. A. Munson. *Acoustical Soc. of America, J.* 9. *pp.* 1–10, *July*, 1937.—The loudness of a complex tone calculated from its acoustic spectrum by the method given [see Abstract 5386 (1933)] gives a result greater than that observed, if the sound is so complex as to approach a continuous acoustic spectrum. The formula here given summarises quantitative results on the relationship between loudness and masking for all types of sound. It is particularly well suited to the complicated types, such as noise, which approach a continuous spectrum when the previous loudness formula has doubtful application. Present results fit the idea of a basic relation between loudness and intensity of stimulus per unit length of basilar membrane. W. H. G.

4635. Sound Emitted by Japanese Hanging-Bells. I. Aoki. *Kyoto Coll. Sci., Mem.* 19. *pp.* 283–292, *Nov.*, 1936. *In English.*—The writer records the sounds of five bells which belong to temples in and near Kyoto by using a Low-Hilger audiometer. These records are analysed into partial sine-curves by periodogram analysis, and the following conclusions are drawn: (1) The frequencies of the fundamental tones are nearly in inverse proportion to the linear dimensions of the bells, but as the bell becomes smaller, the frequency of its fundamental tones becomes smaller than the value obtained by this relation. (2) The frequencies of the partial tones do not change when changing the position of the striking-point along the same meridian line passing through the "Tsukiza" (striking-seat). But their values change when striking different points along the same horizontal line passing through the "Tsukiza." (3) There exists one partial tone between the fundamental tone and what was formerly considered the first overtone. This overtone seems to appear when the size of the bell becomes comparatively large. (4) The frequency of the fundamental tone and its overtones are in approximately the following ratios: $4^2 : 5^2 : 6^2 : 7^2 : 8^2 : \ldots$ AUTHOR.

See also Abstract 4329.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

*4636. **Bridge Balance Indicator. R. L. Garman.** *Rev. Sci. Instruments*. 8. *pp*. 327–329, *Sept*., 1937.—An electronic device for the detection of bridge balance is described. It employs no meters but uses a visual indicator tube. The circuit is so arranged that the sector moves only when the bridge is near balance; this high sensitivity is attained with the small scale available with these tubes. A second tube is used to establish approximate balance and provision is also made for neutraling small residual signals. In this way minimum points may be determined with a high order of precision. AUTHOR.

*4637. **Wheatstone Bridge and Electrolytic Resistor for Impedance Measurements over a Wide Frequency Range. K. S. Cole and H. J. Curtis.** *Rev. Sci. Instruments*, 8. *pp*. 333–339, *Sept*., 1937.—A versatile Wheatstone bridge is described for a.c. impedance measurements at frequencies from 30 to 10,000,000 ∼. Variable electrolytic resistors have proved very satisfactory both for balancing the bridge and as secondary standards of resistance. A selector switch in each working arm permits any one of nine different combinations of impedances to be connected in the arm so that it is possible to make either direct or substitution measurements against either wire-wound or electrolytic resistors. Substitution measurements are made with an electrolytic resistor over the frequency range in 20 min., with an impedance accuracy of 0·2%. The equipment was designed and has been used primarily for impedance measurements of biological materials. AUTHORS.

4638. Laplacian Transform Circuit Analysis. L. A. Pipes. *Phil. Mag*. 24. *pp*. 502–511, *Sept*., 1937.—An account is given of a method for the general solution of linear lumped circuits with constant coefficients by a general operational process. The method is first developed for a general series circuit, and is then generalised for the case of the most general n-mesh circuit. J. J. S.

CONDUCTION AND DISCHARGE IN GASES.

4639. Departure of Feeble Ionisation Currents from Saturation. J. Surugue. *J. de Physique et le Radium*, 8. *pp*. 343–346, *Aug*., 1937.—A study of the influence of electric field-strength on feeble ionisation currents shows that the measured values may be as much as 10% too low. The effect is attributed to maldistribution of the electric field over the ionisation chamber and the improvement suggested is the elimination of angles from the apparatus. F. C. C.

4640. Photographic Study of Vacuum Spark Discharge. J. A. Chiles, Jr. *J. of Applied Physics*, 8. *pp*. 622–626, *Sept*., 1937.—Vacuum spark discharges between electrodes of several different elements were investigated by means of a camera and high speed rotating mirror. It was found that, with very rare exceptions, the luminosity always appeared at the anode before it appeared at the kathode. Measurements were made of the time interval between the appearance of luminosity at the anode and its later appearance at the kathode, and of the velocity of the luminous vapour from the anode. Evidence is given to show that positive ions from the anode have sufficient time to cross the gap during the average observed time intervals. Hypotheses are advanced of the mechanism of the discharge and to account for the observed vapour velocities. Apparently most of the phenomena observed after the formation of vapour at the anode can be accounted for by relatively low gap potentials. AUTHOR.

4641. Transition from Glow to Spray Discharge for Increasing Thicknesses of Anodic Oxide Layers on Al. A. Güntherschulze and W. Bär. *Zeits. f. Physik*, 106. 9–10. *pp*. 662–668, 1937.—It has been shown that a spray discharge is produced [see Abstract 756 (1934)] when a highly insulating material is embedded in the surface of a semiconductor, *i.e.*, a thin film (0·1μ) of Al_2O_3 on Al. This is found unnecessary, since an Al surface evenly coated with oxide, obtained by forming in 5% oxalic acid, shows the spray discharge when it reaches a thickness of 2–10μ. The oxide is shown to be finely porous and the effect of decrease of field strength with increasing thickness is due to the appearance of a space-charge inside the oxide layer. For a coating of Ta_2O_5, there is no sign of a spray discharge. H. M. B.

4642. Absolute Concentration of Excited Atoms in a Mercury Discharge at Low Pressure. W. Fabrikant, F. Butaewa and I. Zirg. *Phys. Zeits. d. Sowjetunion*, 11. 6. *pp*. 576–589, 1937. *In German*.—By measuring the absorption lines corresponding to transitions from the excited states to higher states the number of excited atoms in the three levels of the triplet 6^3P is determined for pressures between 10^{-2} and 10^{-4} mm. Hg at a current strength of 3 A. The numbers are of the order of 10^{11} to 10^{12} atoms/c.c. and their ratios correspond to expectations from the known life-times of these levels and from the calculated transmutation functions. R. P.

4643. Mean Ionising Energy of Gases. E. Bagge. *Ann. d. Physik*, 30. 1. *pp*. 72–90, *Sept*., 1937.—A simple analytical expression is derived for the velocity distribution of the secondary electrons liberated from gaseous atoms. An approximate formula is also obtained for the differential ionisation for atoms with several electrons. Both formulæ are in agreement with experiment in their range of validity and from them the mean ionisation energy for certain gases has been calculated. The results obtained for a primary energy of 20 kV are: in H_2, $\epsilon = 33\cdot9$ V, in N_2, $\epsilon = 28\cdot6$ V and in Ne, $\epsilon = 42\cdot2$ V. G. O. B.

***4644. Braun Tube at Very High Frequencies. H. Hintenberger.** *Zeits. f. techn. Physik*, 18. 9. *pp*. 256–259, 1937.—From calculations of the paths of charged particles in alternating electric fields, taking account of the effect of the stray fields at the edges of the deflecting condenser plates [see Abstract 3249 (1937)], an investigation is made of the dependence of the sensitivity of the Braun tube on the frequency of the applied alternating field. It is found that Hollmann's expression for the frequency at which the sensitivity is least requires a correction factor and, further, that a second set of frequencies exist for which the sensitivity of the Braun tube is zero. A. W.

4645. Intermittent Arc With H.F. Excitation. K. Pfeilsticker. *Zeits. f. Elektrochem*. 43. *pp*. 719–721, *Aug*., 1937.—In place of the mechanical interruption originally proposed by Gerlach, a h.f. circuit is proposed similar to Gerlach's h.f. spark. The high-frequency is imposed upon the mains circuit which is protected by a system of condensers and inductances. Such an arc is more easily examined under reduced pressure or in another atmosphere and can be maintained with smaller current. F. S.

***4646. Time Delay Circuit for Operating Wilson Cloud Chambers. C. C. Jones.** *Rev. Sci. Instruments*, 8. *pp.* 319–322, *Sept.*, 1937.—A circuit has been developed in which grid glow tubes with time delay inputs perform all the switching operations necessary to operate a Wilson cloud chamber and its accessory mechanisms. The cycle of operations can be initiated either at regular intervals (by a motor and reduction gear) or by coincidences in Geiger counters placed above and below the chamber. The change-over from one mode of operation to the other is very simple. AUTHOR.

***4647. Standard Ionisation Chamber. H. Stohlmann.** *Phys. Zeits.* 38. *pp.* 645–654, *Sept.* 1, 1937.—The production of an ionisation chamber in which the ionisation current due to α-particles from U is (*a*) proportional to the air density or (*b*) independent both of air density and polarising voltage is investigated. The design developed is claimed to fulfil these requirements very closely. J. E. R. C.

***4648. Torch Ion-Counter. A. Prokofjev.** *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 16. 1. *pp.* 41–43, 1937. *In English.*—The fact that a spherical electrode of 4 mm. dia. emits a torch-like flame when the electrode is subjected to a h.f. potential, is used to construct a torch ion-counter. The sphere is placed between two flat condenser plates of 40 cm. dia. and separation 20 cm. raised to a p.d. of about 18,000 V. Under these conditions the torch is just quenched but the sphere is very sensitive and emits visible flashes when ionising particles pass close to it. Similar Pb absorption curves for the radiations from a Ra source were obtained with the torch counter and with an ordinary Geiger counter. The latter appears to be more sensitive but the former is especially convenient for counting slow ions. F. C. C.

See also Abstracts **4253, 4515, 4517, 4568, 4666, 4684, 4698.**

CONDUCTION IN SOLIDS AND LIQUIDS.

4649. Electronic Specific Heat and X-Ray Absorption of Metals, and Other Properties Related to Electron Bands. H. Jones and N. F. Mott. *Roy. Soc., Proc.* 162*A*. *pp.* 49–62, *Sept.* 1, 1937.—The energy bands of metals are discussed in relation to the following physical properties: (1) The electron specific heat of metals having closed *d*-shells. It is shown that the linear term is in general greater than that given by Sommerfeld's free electron formula. (2) Electronic specific heat, magnetic and electrical properties of transition metals. These are related to the shape of the *d*-band, which is worked out for body-centred cubic metals, *e.g.*, Ta and W and α-Fe. It is shown that Ta, like other supraconductors, has more than one "conduction" electron per atom. The fine structure of the X-ray absorption edge. AUTHORS.

4650. H.V. Regulation. P. R. Pallister and E. E. Smith. *Journ. Sci. Instruments*, 14. *pp.* 311–313, *Sept.*, 1937.—A method is described for the inspection and control of fluctuations in h.v. supplies, utilising the property of induction between two conductors. AUTHORS.

***4651. Pyrometric Calibration of H.F. Ammeters. H. Hoyer.** *Phys. Zeits.* 38. *pp.* 602–609, *Aug.* 15, 1937.—For the testing of ammeters in the frequency range $3 \times 10^6 \sim$ to $3 \cdot 75 \times 10^7 \sim$ a tungsten single-wire lamp with pyrometer indication was used as a standard, each measurement being checked by the substitution of direct current. The best circuit arrangement was investigated in order to render ineffective parasitic effects depending on the frequency. The symmetrical circuit adopted was coupled to the oscillator inside a double-walled screen in which the oscillator was contained. By earthing the circuit at a suitable point the instruments were arranged to be at current antinodes. Tests on a precision thermo-instrument with a range of 1 A show that at a frequency of $3 \cdot 75 \times 10^7 \sim$ the error is within 1%. L. E.

4652. Surface Conductivity of Diaphragms. S. Komagata and M. Nishikawa. *Zeits. f. phys. Chem.* 179. *Abt.A.* 6. *pp.* 461–465, 1937.—Measurements of the surface conductivity of diaphragms in nine different aqueous solutions (KCl, NaCl, LiCl, NH_4Cl, HCl, $CaCl_2$, $BaCl_2$, $MgCl_2$, and $AlCl_3$), are described using a modification of McBain's method [see Abstract 1679 (1930)], and the results are tabulated. R. L.

4653. Nature of the Supraconducting State. J. C. Slater. *Phys. Rev.* 52. *pp.* 214–222, *Aug.* 1, 1937.—Further analysis is made of the author's suggestion [see Abstract 1336 (1937)] that the electrons in the supraconducting state may be in stationary states lying below the continuum of levels predicted by energy band theory. The wave functions considered are shown to carry no current in the ordinary way, since they correspond to the correlation of an electron and a positive ion, and the two move together. They do, however, resemble large atoms and should show large diamagnetism. In this the theory is similar to that suggested by London. It is shown that to produce supraconductivity the orbits must be of the order of magnitude of 137 atomic diameters. This is considered reasonable for the type of model in question, and the limiting magnetic field above which the diamagnetism or supraconductivity should disappear is of the correct order of a few hundred gauss. R. W. P.

4654. Magnetic Induction in Supraconductors. J. Stark and K. Steiner. *Phys. Zeits.* 38. *p.* 597, *Aug.* 15, 1937.—As a supplement to a recent paper [see Abstract 2768 (1937)] it is stated that when the windings on the tubular single crystal of tin are increased from 100 to 700, evidence is obtained which shows that suitable lowering of the temperature for the production of the supraconducting state can result in an initial paramagnetic induction. Further decrease in temperature causes the deflection to diminish and become of opposite sign. This is then consistent with the diamagnetic induction reported previously. R. W. P.

4655. Supraconductors in Alternating Magnetic Fields. J. G. Daunt. *Phil. Mag.* 24. *pp.* 361–377, *Sept.*, 1937.—In order to investigate the transition from the supraconductive to the normal state under conditions where coexistence of material exhibiting these two states is expected, and to study the formation and shape of these regions in different phases of the destruction and reappearance of supraconductivity, electromagnetic changes inside a long hollow cylinder of pure polycrystalline Sn in longitudinal and transverse alternating magnetic fields of the order of 1 gauss were examined. Curves for the disturbance of supraconductivity in these fields are given and discussed. The phenomenon is more complicated in the transverse than in the longitudinal field; in the latter, the destruction of supraconductivity occurs suddenly at the threshold value at which the shielding persistent currents over the whole specimen break down; in the former, the transition begins where supraconductivity, according to electrodynamic theory, has first to break down on the surface of the cylinder. A study is also reported of the time effects which occur after changes of temperature or magnetic field if macroscopic supraconductive and normal regions are in coexistence. N. M. B.

4656. X-Ray Spectrographic Study of Conduction Electrons in Mg-Al Alloys. J. Farineau. *Comptes Rendus*, 205. *pp*. 365–366, *Aug*. 9, 1937.—The alloys Al_3Mg_2 and Al_2Mg_3 have been examined by means of a crystal spectrometer operating *in vacuo*. The same rays are obtained as in the case of the pure metals with the exception of the βx bands, which are due to the conductivity electrons in the K levels. The short wave-length edge of these bands is in the same position as in the case of the pure metals, but the appearance of the bands is different. Calculations, assuming that these electrons obey Fermi statistics, give band widths of 9·4 and 9·0 eV for Al_3Mg_2 and Al_2Mg_3 respectively, which are slightly less than the experimentally found values. He concludes that the Mg and Al atoms share in common the valency electrons and that these electrons can fall indifferently into one ion or another, in order to emit the X-ray band in question. G. G.

4657. Electrical and Thermal Investigations on Manganin. A. Schulze. *Phys. Zeits.* 38. *pp*. 598–601, *Aug*. 15, 1937.—By determining the temperature of recovery of cold-worked manganin wires, and a study of their resistance-temperature curves after ageing at various temperatures, information is obtained regarding the best treatment to ensure good electrical properties, *viz.*, low temperature coefficient of resistance and small change in resistivity with time. Heat treatment at from 375° C. to 400° C. is recommended instead of at about 150° C. as is usual at present. R. W. P.

4658. Conduction of Electricity in Solids. *Phys. Soc., Proc.* 49. *pp*. 3–154, *Aug*. 31, 1937. *Bristol Conference.*—A general Discussion of the subject comprising 13 papers and preceded by an Introduction by **N. F. Mott.**

Part I. Conduction in Non-Metals.

" Electron Conductivity and Photochemical Processes in Alkali-Halide Crystals," by **R. W. Pohl** (*pp*. 3–31). A presentation of the most important results of many years work on artificially-produced crystals under the following headings: (1) Optical properties of the alkali-halide crystals in their pure state as well as when containing a stoichiometric excess of one of the components, *i.e.* either alkali, metal or halogen; (2) Photoelectric currents in crystals; (3) Motion of electrons thermally released, and the connexion between electron conductivity and ionic conductivity; (4) Photochemical processes in the crystals. The paper concludes with 92 references to the subject.

" Trapped Electrons in Polar Crystals," by **R. W. Gurney** and **N. F. Mott** (*pp*. 32–35). An attempt to show how an extra electron may be expected to behave in a crystal without crystal imperfection, accepting the current theory of polar lattices. Tentative suggestions are made about the connexion between the authors' findings and the experimental material. The paper is based on an idea due originally to Landau and developed further by Frenkel and the authors. A very similar idea has been used by von Hippel.

" Alkali-Halide Phosphors Containing Heavy Metals," by **R. Hilsch** (*pp*. 40–45). An account of some of the work on alkali-halide phosphors. The phenomena are simplest in phosphors activated by heavy metal halides. The discussion of these form the main feature of the paper.

"Effects of Temperature on the Intensity of Fluorescence of some Impurity Solids," by **J. T. Randall** (*pp.* 46–56). An account of some preliminary measurements from which some points of rather general significance are deduced.

"Semiconductors with Partially- and with Completely-Filled 3*d*-Lattice Bands," by **J. H. de Boer and E. J. W. Verwey** (*pp.* 59–71). Attention is drawn to a class of semiconductors or insulators with incompletely-filled 3*d* bands. Their lack of conductivity, if the number of electrons per atom is an integer, is explained. A tentative explanation is given of the fact that photoconductivity is generally observed with substances with completely-filled zones and never with substances of the NiO type. The case of non-stoichiometric ZnO is considered.

Part II. Conduction in Alloys.

"Resistance of Alloys with Disordered and Ordered Arrangement of Atoms," by **G. Borelius** (*pp.* 77–95). The following matters are discussed: (1) Resistance-concentration diagrams; (2) Resistance of dilute solid solutions of *b* metals in Cu, Ag and Au; (3) Resistance of solid solutions of transition metals in Cu, Ag and Au; (4) Development of transformations from disordered to ordered atomic arrangements; (5) Continuous variations of degree of order; (6) Definitions of degree of order; (7) Antiphase regions in partly ordered crystals; (8) Disordering by mechanical treatment; (9) Hysteresis between the ordering and disordering transitions; (10) Hysteresis at the segregation process.

"Order-Disorder Transformation," by **W. L. Bragg, C. Sykes and A. J. Bradley** (*pp.* 96–102). The general nature of the order-disorder transformation is discussed. A *résumé* of the theory of the dependence of order upon temperature and the results of measurements of energy changes due to the formation of the super-lattice are given. The time of relaxation and the influence of order on magnetic properties are also discussed. The paper concludes with a summary of the programme of work in hand at Manchester University and in the research laboratory of the Metropolitan-Vickers Electrical Co.

"Age-Hardening Alloys," by **C. H. Desch** (*pp.* 103–107). Attention is drawn to certain effects observed in alloys the explanation of which will have to be sought in the properties of the lattice, and in the changes of energy with temperature in lattices composed of more than one kind of atoms.

Part III. Conduction in Thin Films.

"Structure of Thin Metallic Films," by **G. I. Finch** (*pp.* 113–117). Attention is drawn to those structural features revealed by electron diffraction studies, which are likely to give rise, at least in part, to the abnormally low conductance associated with thin metallic films.

"Factors Influencing the Resistance of Thin Metal Films," by **E. T. S. Appleyard** (*pp.* 118–135). A brief enunciation of and an attempt to explain some of the chief experimental observations on the resistance of thin metal films prepared by evaporative deposition in a good vacuum.

"Electrical Properties of Thin Films of Platinum Obtained by Kathode Sputtering in Air and other Gases," by **A. Féry** (*pp.* 136–137).

"Fluctuations in Resistance of Thin Films," by **J. Bernamont** (*pp.* 138–139). An equation is derived to represent the variation of resistance of thin films under certain conditions.

"Migration and Aggregation of Atoms on Solid Surfaces," by **J. E. Lennard-Jones** (*pp.* 140–149). Mathematical paper dealing with critical phenomena in adsorbed films, and the migration of atoms along solid surfaces.

Discussions on the various papers reported by **N. F. Mott** and **E. T. S. Appleyard,** contain some important comments. R. L.

4659. Conductivity Measurements with Cuprous Oxide. J. Gundermann, K. Hauffe and C. Wagner. *Zeits. f. phys. Chem.* 37. *Abt.B.* 1–2. *pp.* 148–154, 1937.—The proportionality of the electrical conductivity of Cu_2O with the 7th root of the O_2 pressure has now been confirmed by measurements at 900° C over an extensive region of pressure. At quite small pressures, the indication of a transition to a special lattice conduction has been definitely established, an observation previously made by Schottky and Waibel from measurements of the Hall effect. At lower temperatures (800° and 700° C), unexplained deviations of other kinds have been found at low pressures. From the electrometric measurements of Treadwell, the decomposition pressure of the Cu_2O-phase has been recalculated [see following Abstract]. H. H. Ho.

4660. Transport Measurements for Cuprous Oxide. J. Gundermann and C. Wagner. *Zeits. f. phys. Chem.* 37. *Abt.B.* 1–2. *pp.* 155–156, 1937.—The transport number of the Cu^+ ion in Cu_2O at 1000° C (5×10^{-4}) is found to be independent of the O_2 pressure. The partial conductivity due to the Cu ions is, therefore, like the electron partial con-conductivity approximately proportional to the 7th root of the O_2 pressure [see preceding Abstract]. These results have confirmed earlier data. [See also following Abstract.] H. H. Ho.

4661. Conductivity Measurements with Cupric Oxide. J. Gundermann and C. Wagner. *Zeits. f. phys. Chem.* 37. *Abt.B.* 1–2. *pp.* 157–160, 1937.—The conductivity of CuO at room-temperature is found to be dependent to a far reaching extent on its previous history. Tables of data are included showing the effects of the temperature and O_2 pressure existent at the previous equilibrium condition. Other unknown factors are considered to be present in order to account for the results obtained. [See preceding Abstract.] H. H. Ho.

4662. Electrical Conductivities and Viscosities of KCl, NaCl and LiCl Solutions. L. Nickels and A. J. Allmand. *J. Phys. Chem.* 41. *pp.* 861–872, *June,* 1937.—The electrical conductivities, densities, and viscosities have been determined at 25° C. for solutions of KCl, NaCl and LiCl in water and in 0·1 *M* HCl. The weight concentrations of the alkali metal chlorides were varied between about 0·1 *M* and upper limits of 3·8 to 5·8 *M*. The dependence of the equivalent conductivity–viscosity product on the concentration of the alkali metal chloride, dissolved either in water or in 0·1 *M* HCl, is discussed in the light of the views of Bernal and Fowler on the nature of the viscosity of electrolytic solutions. AUTHORS.

***4663. Insulation Measurements. P. M. Pflier.** *A.T.M. No.* 74. *T*101–*T*102, *Aug.,* 1937.—Describes methods and apparatus for the measurement of high insulation resistances, using d.c. indicating instruments in conjunction with batteries, or with rectifying devices connected to a.c. networks. E. R.

***4664. Instrument Suspensions. L. Walden.** *Journ. Sci. Instruments,* 14. *pp.* 257–268, *Aug.,* 1937.—Describes the preparation of fine silica fibres, the methods of producing electrically-conducting coatings on the fibres, and the procedure to be adopted in mounting the suspensions.

The production and manipulation of fine metal filaments for use as instrument suspensions are also dealt with. E. R.

See also Abstracts 4302, 4616, 4708.

DIELECTRICS AND CAPACITANCE.

4665. Matrix Study of Electric Moment. M. Courtines. *Ann. de Physique*, 8. *pp.* 5–145, *July–Aug.*, 1937.—The theories of van Vleck and Niessen are based on making simplifying assumptions in the case of the former and, for the latter, on the theorem of means. A matrix study of electric moment is developed so as to investigate the limits of validity of Niessen's theorem and the possibility of substantiating van Vleck's hypotheses. W. R. A.

4666. Gas Dielectrics. A. Güntherschulze. *Arch. f. Elektrot.* 31. *pp.* 495–507, *Aug.* 10, 1937.—A summary of recent work and theory on the dielectric properties of gases, with particular reference to electric strength phenomena and corona and brush discharges. E. R.

4667. Dielectric Polarisation of Iodine Solutions. S. W. Kaftanow, W. Wassiliew and J. Syrkin. *Acta Physicochimica*, 7. 1. *pp.* 75–84, 1937. *In English.*—The polarisation of iodine solutions in benzene was measured at 15, 25, 40, 55 and 60° C. for the following concentrations (in mole fractions): 0,004222, 0,006085, 0,007860, 0,014917 and 0,025328. For all these temperatures, the calculated values of molar polarisation were equal to $41 \cdot 12 \pm 0 \cdot 12$ cm^3. The independence of polarisation on the temperature affords the conclusion that iodine has no dipole moment in benzene. Nor does it possess any moment in CS_2. The question of the appreciable difference between the electronic polarisations in vapour (32,2) and in solution is discussed. AUTHORS.

4668. Possible Explanation of Anomalous Electric Dipole Moments. F. C. Frank and L. E. Sutton. *Faraday Soc., Trans.* 33. *pp.* 1307–1316, *Sept.*, 1937.—A new, general solvent effect is suggested and investigated theoretically. It arises from the combination of local dipole fields and the field applied for measurement in producing local changes of solvent density and thus of solvent effect upon apparent moment. Its value depends only upon the nature of the solvent, the moments of polar groups in the solute, and their number; it is independent of the total moment of the solute molecule. It is therefore not zero for non-polar molecules containing balanced polar groups, and may explain the anomalous apparent moments reported for a number of such substances. The exact dependence of the effect upon solute, solvent, and temperature is discussed. An absolute value for the polarisation of *p*-benzoquinone in benzene solution is calculated, and is in good agreement with the observed value. The effect is compared with the one suggested by H. O. Jenkins and S. H. Bauer. AUTHORS.

4669. Organic Substances in Electric and Magnetic Fields. E. Müller. *Naturwiss.* 25. *pp.* 545–556, *Aug.* 20, 1937.—Surveys recent work in theoretical organic chemistry based on electric and magnetic phenomena. Examples of the behaviour of organic substances in the electric field are shown to afford conclusions as to molecular structure from the charge distributions. The behaviour of organic substances in the magnetic field is considered at some length. Theoretical foundations are discussed and methods of measurement described. Sections are then devoted to diamagnetic and paramagnetic compounds, the determination of heats of dissociation, and the investigation of biradicals, of metallic ketylenes and finally of vitamine B_2. The conclusion is drawn that the magnetic method is an indispensable research tool for the study of free radicals and that in contrast to many other physical methods it leads not only to valuable confirmation concerning known phenomena but affords an independent means of research. H. H. Ho.

4670. Electrical Saturation in Dilute Nitrobenzene Solutions. A. Piekara. *Phys. Zeits.* 38. *pp.* 671–674, *Sept.* 1, 1937.—Recently [see Abstracts 347 and 3235 (1937)] experiments on the influence of an electric field on the dielectric constants of solutions of nitrobenzene in benzene and in hexane have shown that the electric field causes a diminution in the dielectric constant when the concentration of the nitrobenzene is not greater than about 93%, a result in qualitative agreement with the Debye theory. The present work now proves to what extent the Debye theory is valid as the solutions tend to infinite dilution, and how far combination of solute and solvent takes place. The measurements have been made in non-dipolar solvents and the results extrapolated with respect to the concentration, but in the present paper only the data are discussed and the experimental section postponed to a later publication. From the data in benzene, CCl_4 and hexane it follows that the mutual coupling of the nitrobenzene molecule with the solvent very rapidly increases with concentration, and differs in extent according to the solvent, being least with hexane and greatest with benzene. The author opines that the deformation moment of the nitrobenzene molecule is due to a displacement of the two O atoms bound to the N which attract or repel in consequence of the induced displacement moment. H. H. Ho.

4671. Limitations of H.V. Insulation. J. B. Whitehead. *Frank. Inst., J.* 224. *pp.* 363–379, *Sept.*, 1937.—The insulating properties of present available materials impose limitations on the increasing tendency to higher transmission voltages. In overhead transmission systems, considerations of the dielectric properties of air and porcelain at high voltages have necessitated special types of conductor, wider spacing and higher towers, together with devices for protecting the porcelain insulator string from damage during lightning. The progressive deterioration of the insulation in h.v. underground cables due to gaseous ionisation has led to the introduction of oil-filled cables and pressure cables. E. R.

4672. Moisture Determination in Solids from Dielectric Constants. S. Knoke. *Zeits. f. Elektrochem.* 43. *pp.* 749–751, *Sept.*, 1937.—A suitable immersion method with special cell is described for the determination of the dielectric constants of solids which has been specially designed for the moisture evaluation of powders. Data are given for certain tannins. The error is $< \pm 0{\cdot}1\%$. H. H. Ho.

4673. Absorption Bands in Polar Substances at Very High Frequencies. L. Cavallaro. *Accad. Lincei, Atti,* 25. *pp.* 382–387, *April* 18, *and pp.* 509–515, *May* 8, 1937.—The theory of Debye, according to which polar liquids should show absorption and dispersion in the region of short waves is summarised and extended. Experiments are made on a number of organic liquids, in the region between 2·6 and 22 m. A condenser that forms part of the resonance circuit can be filled with the liquid in question. The reduction in intensity is then a measure of the absorption in the liquid while the change in the resonance frequency is a measure of the dielectric constant. Both are studied in dependence on frequency and temperature. The results are in qualitative agreement with the theory. R. P.

4674. Dependence of Dielectric Loss in Ketones on Molecular Constitution and Size. W. Holzmüller. *Phys. Zeits.* 38. *pp.* 574–587, *Aug.* 1, 1937.—Determinations of h.f. dielectric loss in a number of ketones are described, using a thermal method by which a power factor of 0·0001 can be measured to an accuracy of 5% at 3·8 m. wave-length. It is found that the relaxation times increase—not linearly, but at a greater rate—with increasing size of molecule. Molecules of equal size and moment but of differing structure, have very different relaxation times. The results are generally in good agreement with the Debye dipole theory, any deviations being explained from a consideration of the structure of the polar molecule and the limited application of Stokes' law to molecules of small size. E. R.

See also Abstracts 4301, 4369, 4468, 4563.

ELECTROCHEMISTRY.

4675. Thermodynamical Treatment of Diffusion Potentials. J. J. Hermans and L. J. Oosterhoff. *Phil. Mag.* 24. *pp.* 304–312, *Aug.*, 1937.—Guggenheim's recent paper is criticised [see Abstract 354 (1937)], and the authors show that the possibility of superposing the processes which occur in cells with liquid-liquid junctions does not imply that the processes are independent of each other, *e.g.*, with regard to heat-effects, and that the thermodynamical derivation breaks down. The demonstration is given by means of an analogy which exists between a cell with diffusion and a short-circuited one, once the former is actually an internally short-circuited cell. The identity of results between the thermodynamical and kinetic treatment of ideal solutions which led to the opinion that the same thermodynamical treatment can also be applied to non-ideal solutions is examined, and the cause of identity indicated while the above opinion for non-ideal solutions is shown to be erroneous. It is opined that the determination of ion activities at least in principle cannot be regarded as impossible, and they are not " physically undefined " as Guggenheim supposes. H. H. Ho.

4676. Sodium Vapour Potential and the Gay-Lussac Reaction. O. Barta. *Zeits. f. Elektrochem.* 43. *pp.* 733–743, *Sept.*, 1937.—The constants of the Gay-Lussac reaction have been evaluated from measurements with the following cells and compared with manometric determinations: C, Na(gas)| soda|O_2 (Gay-Lussac cell) ; Na(gas)|soda|O_2 ; Na(liquid)|soda |O_2 ; Na (liquid)|Na_2O(solid)|O_2. The dissociation constant of Na_2CO_3 was derived from these cell measurements ; also the free energy of formation of Na_2O has been calculated from thermodynamic considerations and found to be in agreement with the corresponding cell measurement. Experimental details are included. H. H. Ho.

✱**4677. Electrolysers, with Mercury Kathode. O. Dony-Hénault and A. de Jaer.** *Comptes Rendus*, 205. *pp.* 225–227, *July* 19, 1937.—After a theoretical discussion on the possibility of utilising the energy of decomposition by H_2O of the alkali metal amalgam in the electrolytic preparation of alkali, it is shown experimentally that partial utilisation is possible if the shunt is removed, and a small auxiliary cell is associated with the amalgam-producing (A) and -decomposing (P) compartments, arranged so as to produce rich amalgam, and discharge it into A, whence it passes into P, and so compensate for the deficit thereof. One such auxiliary cell consuming 6 A is sufficient for an electrolysing cell using

40 A. In this way economies of 12·7 and 8% were effected with current densities of 1000 and 2000 A/m^2. respectively. [See Abstract 2794 (1937).] C. A. S.

4678. Electrolytic Formation of Persulphate. Part III. R. Matsuda and T. Nishimori. *Chem. Soc. Japan, Bull.* 12. *pp.* 331–335, *July,* 1937.—The influence of igniting a Pt-anode prior to its use in electrolysis was studied in Part II [see Abstract 358 (1937)], and several other treatments are dealt with in the present paper. The length of the Pt-wire kathode has also been varied to ascertain the influence of the kathodic current density but without any noteworthy results. Experiments with PbO_2- and C-anodes are also described, but these anodes are found to be inefficient. H. H. Ho.

4679. Anode Reactions. W. D. Bancroft. *Am. Electrochem. Soc., Trans.* 71. *pp.* 195–205; *Disc.,* 205, 1937.—The theory of the formation of persulphuric acid and persulphates is considered from several points of view in the light of results obtained by a number of experimenters. Anode reactions are given for solutions of Na_2SO_4, H_2SO_4, Na_2SO_3, and $Na_2S_2O_3$. The formation of persulphate and of tetrathionate ions is shown as the polymerisation of partially discharged ions. It is concluded that there is no justification for assuming that, in the formation of persulphuric acid, the mechanism is $2HSO_4^- + O + H_2O \rightarrow H_2S_2O_8 + 2OH^-$. [See also Abstract 321 (1936).]

4680. Electrolytic Recording of Weak Electric Currents. F. E. Lutkin. *Journ. Sci. Instruments,* 14. *pp.* 306–308, *Sept.,* 1937.—Solutions for use in electrolytic recording are described which give dark-coloured permanent records. These solutions are about five times as sensitive as the starch iodide solution usually employed for this work. AUTHOR.

4681. Transference Numbers of KCl, NaCl and LiCl Solutions. L. Nickels and A. J. Allmand. *J. Phys. Chem.* 41. *pp.* 873–886, *June,* 1937.—The transference numbers of KCl, NaCl and LiCl solutions both in water and in 0·1 *M* HCl, have been investigated at room-temperature by the Hittorf method over considerable ranges of concentration. Both anode and kathode layers were analysed, and the majority of the experiments were done in duplicate. The agreement with neutral solutions between the values obtained by analysis of the anode and kathode layers suggests that the high hydration values which have been ascribed to the alkali metal kations in dilute solution, as the result of transference measurements with and without a reference substance, are spurious. In the acid solutions, the H-ion and the alkali metal kations appear to carry, respectively, less and more of the current than would be expected from their mobilities in solutions of the corresponding single electrolyte. Connected with this is the existence of a so-called "middle layer effect," which causes certain experimental difficulties. These last phenomena are discussed in the light of (i) the extended Onsager theory due to Bennewitz, Wagner, and Küchler and (ii) the views of Bernal and Fowler on the nature of the conductance of the H-ion. AUTHORS.

***4682. pH Measurement by Photoelectric Method. G. F. Lothian.** *Faraday Soc., Trans.* 33. *pp.* 1239–1243, *Sept.,* 1937.—A method is described for the precise determination of pH values with indicators, by means of photoelectric measurement of light absorption. The conditions for obtaining the greatest precision are elaborated, and results are given for methyl red. AUTHOR.

***4683. pH Measurement With Glass Electrode. D. A. MacInnes and L. G. Longsworth.** *Am. Electrochem. Soc., Trans.* 71. *pp.* 73–88; *Disc.*, 89–91, 1937.—The history of the glass electrode is briefly outlined and the construction of the more modern types of the electrode is discussed, together with the methods for potential measurement. An account is made of the comparison of the glass and the standard hydrogen electrode. An apparatus for accurate routine pH measurements with the glass electrode is described, also an apparatus used for maintaining the pH constant during bacterial growth. AUTHORS.

***4684. Effect of Sodium Ions on Amalgamation of Thin Layers of Silver. H. Kehler.** *Zeits. f. Physik*, 106. 5–6. *pp.* 296–310, 1937.—Thin films of Ag deposited on glass, mica or collodion were bombarded with Na ions of different energies. The films were subsequently exposed to the action of Hg vapour and it was observed whether amalgamation took place. Consistent results were obtained with the films on mica and collodion but not with the films on glass. Bombardment with ions of energy of 100 to 500 eV rendered the Ag films passive to the action of the Hg vapour provided the total number of ions per unit area was sufficient. Ions of from 500 to 1300 eV activated the surface initially but, with a greater total ion "covering," also rendered the surface passive. The number of ions required to produce passivity equalled about 30% of the number necessary to form a monomolecular coating. It is suggested that the ions act by blocking vulnerable spots in the crystallites forming the Ag film. For the production of the Na ions a new form of Kunsman anode was used which is described in detail. W. S. S.

See also Abstracts 4271, 4629, 4659, 4660, 4661.

ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATIONS.

4685. Symmetrical Theory of Electrons and Positrons. E. Majorana. *N. Cimento*, 14. *pp.* 171–184, *April*, 1937.—A new method of quantisation is proposed which allows Dirac's theory of the positron to be built up in such a form that there is complete symmetry between the positive and negative charge throughout the formalism of the theory, while in Dirac's original form this symmetry applied only to the results of the theory, which had to be obtained by using ambiguous mathematical operations such as subtraction of infinities. It is also claimed that the new method of quantisation is capable of describing a neutral particle without states of negative kinetic energy and without introducing a "mirror image" like the positron. R. P.

4686. Magnetic and Electric Moment of the Electron in Dirac's Theory. W. Kofink. *Ann. d. Physik*, 30. 1. *pp.* 91–98, *Sept.*, 1937.—A mathematical relation between the electric and magnetic moment, the current and the spin of an electron is derived from Dirac's theory. R. P.

4687. Magnetic Moment of the Proton. I. Estermann, O. C. Simpson and O. Stern. *Phys. Rev.* 52. *pp.* 535–545, *Sept.* 15, 1937.—The magnetic moment of the proton was measured by the method of the magnetic deflection of molecular beams employing H_2 and HD. The result is $\mu_p = 2{\cdot}46\ \mu_0 \pm 3\%$. AUTHORS.

4688. Vibratory Doublets. E. T. Jones. *Phil. Mag.* 24. *pp.* 458–466, *Sept.*, 1937.—A suggestion recently made by the author [see Abstract 5688 (1936)] that electrostatic forces represent the variation of the mutual energy of electrons regarded as coupled oscillatory systems, led to the result that the frequency of each of two electrons of opposite sign becomes zero when they approach to a certain critical distance ($r_0 = 2{\cdot}8 \times 10^{-13}$ cm.) and remains zero at shorter distances. The present paper deals with the following properties of these doublets, which have zero energy when free and at rest, *viz.*, the common frequency of two stationary electrons at various distances apart; the energy of a moving doublet; the doublet and the photon. The author opines that there are no known facts which are definitely contrary to the view now suggested that a photon is a vibratory doublet in translational motion; the latter theory is based upon the presumed fact that an electron has the characteristics of an oscillator, for which there is strong experimental evidence. H. H. Ho.

4689. Explanation of Maximum in Secondary Emission From Metals. D. R. Bhawalkar. *Indian Acad. Sci., Proc.* 6*A*. *pp*. 74–78, *July*, 1937.—It is well-known that the curve plotted for ' I_s/I_p : V,' where ' I_s ' is the total secondary electrons corresponding to the primary electrons ' I_p ' of energy ' V ' volts, shows a flat maximum at higher values of ' V.' The presence of this maximum is explained on the assumption that the rate of loss of energy of the primary electrons obeys the Thomson-Whiddington law and the secondary electrons generated at various depths are absorbed by the target on their way out. The relation derived on this assumption shows the dependence of the value of the voltage, corresponding to this maximum, on the density of the metal as has been observed experimentally. AUTHOR.

4690. Calculation of the Penetrating Power of Electrons of a Few Million Volts. S. Franchetti. *Accad. Lincei, Atti*, 25. *pp*. 468–474, *May* 8, 1937.—The formula of Bethe and Williams for the loss of energy by electrons passing through matter is evaluated for the case of Al, and the necessary integration performed numerically. It is found that the theoretical range is greater than the experimental. This is due to scattering, which increases the effective path of an electron passing through a given thickness of matter. An approximate method for taking the scattering into account is developed. R. P.

4691. Absorption of High Energy Electrons. Part II. J. J. Turin and H. R. Crane. *Phys. Rev.* 52. *pp*. 610–613, *Sept*. 15, 1937.—Cloud chamber measurements of the energy loss of electrons in passing through Pb and C absorbers have been extended up to 11 eMV by using the β-rays from Li^8. The values for the average energy loss for lead are more than 50% greater than those predicted by the Bethe-Heitler theory. Part of this difference, at least, is accounted for by the fact that the actual length of path of an electron in lead is somewhat greater than the thickness of the lead. If a reasonable value (1·25 to 1·75) is used for the path length-thickness ratio, the experimental values can be said to be in agreement with theory, using a path length-thickness ratio of unity, which is reasonable, because of the smaller amount of scattering in C than in Pb. [For Part I see Abstract 4187 (1937).] AUTHORS.

4692. Characteristic Vibrations of a Fermi Gas with an Application to Bloch's Formula for the Stopping of Fast Particles. H. Jensen. *Zeits. f. Physik*, 106. 9–10. *pp*. 620–632, 1937.—The hydrodynamical equations for the vibrations of an electron gas that satisfies the Fermi-Dirac statistics are solved for the special case in which the density of the gas is constant inside a sphere and vanishes outside. The results provide also an approximate way of obtaining the vibrations of a Fermi-Thomas atom, which are of importance in Bloch's theory of the energy loss by fast particles [see Abstract 2606 (1933)]. In this way a numerical constant which Bloch had determined empirically can be estimated and satisfactory agreement obtained. If exchange forces are allowed for in a simple way the agreement with the experiment becomes rather worse for light atoms. R. P.

4693. Standard Substances for Exact Measurements by Electron Diffraction. N. A. Šišakov. *Comptes Rendus* (*Doklady*) *de* l'*Acad. des Sciences, U.S.S.R.* 15. 8. *pp.* 461–462, 1937. *In English.*—Different methods for employing standard specimens to eliminate the uncertainty with regard to wave-length in electron diffraction are reviewed and the requirements to be fulfilled by a suitable reference material are discussed. The lattice parameters of Au, Ag and Ni are not constant in thin films, whilst a great variation in crystal size is observed in the case of NaCl. It is claimed that these difficulties may be overcome by using as reference substance the " two-dimensional crystals " of Si_2O_5 discovered by the author. Such specimens are easily prepared and the lattice parameters have been shown to be constant to within 0·3%, corresponding to a hexagonal network with $a = 5{\cdot}161$ Å. A. G. Q.

***4694. Magnetic Electron Microscope. J. H. McMillen and G. H. Scott.** *Rev. Sci. Instruments,* 8. *pp.* 288–290, *Aug.,* 1937.—A simple form of magnetic electron microscope is described which was designed primarily for the examination of biological sections and which from simplicity of construction, design and theory of operation recommends itself as a demonstration instrument. The microscope comprises a directly heated oxide kathode and a fluorescent screen about 80 cm. distant, in a tube which during operation is evacuated to a pressure of less than 10^{-4} mm. Hg. A single iron-cased adjustable magnetic coil is used for focusing and a second coil is used for adjustment of position of image on screen. The instrument has a maximum magnifying power of 50 diameters. J. E. K.

***4695. Direct Observation of Structural Changes at High Temperatures with the Electron Microscope. W. G. Burgers.** *Zeits. f. Metallkunde,* 29. *pp.* 250–251, *Aug.,* 1937.—An electron microscope suitable for observing the surface structure of activated metals is described and a series of photographs are given to illustrate its use in following visually or photographically the $\alpha \rightleftarrows \gamma$ transformation in Fe at about 900° C. H. J. H. S.

4696. Action of a Homogeneous Magnetic Field on the Motion of Electrons between Coaxial Cylindrical Electrodes. G. Grünberg and V. Wolkenstein. *Techn. Phys. U.S.S.R.* 4. 3. *pp.* 179–199, 1937. *In German.*—In this paper, which is almost wholly mathematical, it is first shown that if the initial velocity of the electrons can be neglected, the solution may be obtained by the solution of a second-order differential equation having only a single parameter $\mu = H^2 r^{4/3}/I^{2/3}$, when H represents the field-strength, r the radius of the kathode and I the anode current. Tables of the appropriate integrals are given to facilitate calculations of the electron paths. G. E. B.

***4697. Thyratron Stimulator-Timer Used in Conjunction with the Kathode-Ray Oscillograph. A. S. Harris.** *Rev. Sci. Instruments,* 8. *pp.* 345–348, *Sept.,* 1937.—Arrangements are described whereby the thyratron oscillator may be adapted to serve as a relatively inexpensive stimulating and timing unit of a kathode-ray oscillograph assembly. By coordinating the thyratron oscillation with the 60-cycle a.c. sine wave a system is provided for measuring both the velocity of the oscillograph sweep and the frequency of the oscillator. A method of calibrating the frequency of the oscillator for use as a multiple-frequency stimulator away from the oscillograph is described. AUTHOR.

See also Abstracts **4240, 4241, 4262, 4287, 4357 4362, 4455, 4505, 4577, 4644, 4654, 4746.**

ELECTROSTATICS.

4698. Carrier Mobility Spectra of Spray-Electrified Liquids. S. Chapman. *Phys. Rev.* 52. *pp.* 184–190, *Aug.* 1, 1937.—The mobility spectrum of spray-electrified salt solutions was investigated with an Erikson mobility tube under conditions of high resolving power. In general there are no charged carriers of mobility greater than 1·7 cm./sec. per volt/cm. Then the curves rise sharply, level out, and approach a broad maximum in the region between 0·05 and 0·10 cm./sec. per volt/cm. and then very gradually decrease toward zero. Superposed on this background striking peaks are observed indicating groups of unique mobility. With sprayed distilled water the most prominent peaks occur at mobilities of 1·5 for the negatives and 0·9 for the positives. Carriers of both signs occur in about equal quantities. With salts in the water the electrification increases up to a concentration of about $1 \cdot 0 \times 10^{-4}$ N. It is then about double that for distilled water but at higher concentration it decreases. The salt occasions very strong peaks at mobility 0·5. It is concluded that the peaks represent stable groupings. J. J. S.

***4699. D.C. Generator for 3,000 kV. A. Bouwers and A. Kuntke.** *Zeits. f. techn. Physik,* 18. 9. *pp.* 209–219, 1937.—Problems of atomic structure have been investigated by means of high voltages of at least 1 MV. One of the first methods of producing voltages of this order was Marx's surge generator, using condensers charged in parallel and discharged in series. The van de Graaff generator uses an electrostatic principle and its current capacity is restricted. The authors' generator is based on the Villard principle. The series condensers each attain a p.d. of twice the peak voltage of the transformer. A 7-stage generator of this type produces 1·5 MV to earth, positive or negative according to the connections of the rectifiers: it stands 5·6 m high. The valves are gasfilled to obtain large current and low voltage drop. They consist of long tubes with the kathode at one end and the anode at the other, and a number of cylindrical electrodes in between connected to external condensers so as to produce a uniform potential gradient along the tube between anode and kathode. A 225-kV valve is 68 cm. long. The kathode heaters may be energised by small dynamos with insulated shafts, or by superimposing a h.f. current on the generator structure and employing series h.f. transformers. Voltage measurements are made by means of an oil-cooled resistance divider carrying about 1 mA. in connection with an electrostatic voltmeter. M. G. S.

4700. Shielding Effect of a Faraday Cage at Broadcasting Frequencies. W. Lampe and E. Ferroni. *Phys. Zeits.* 38. *pp.* 637–644, *Sept.* 1, 1937. *From the Reichsanstalt.*—Describes measurements effected in the Laboratory resulting from experiments carried out on a band of frequencies of 100 to 1600 kc./sec. (3000–180 m). The experimental arrangements are described and the results embodied in a series of tables and curves. H. H. H.

See also Abstracts **4234, 4235, 4341, 4688.**

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

See Abstract 4701.

MAGNETISM AND ELECTROMAGNETISM.

4701. Theory of Dependence of Ferromagnetic Properties of Metals on Temperature. N. Akulov. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 15. 8. *pp.* 445–450, 1937. *In English.*—Ferromagnetic crystals are to-day regarded as consisting of areas of spontaneous magnetisation. The structure of these areas is not yet clear and a simple pattern is suggested which permits development of the theory of the dependence of ferromagnetic phenomena on temperature. Each area of spontaneous magnetisation with resultant spin J_t is, under the action of temperature, divided into a group of smaller areas having the moment $J_0 > J_t$ (J_0 = saturation at absolute zero). The spins J_0 precess about J_t at different angles I_m representing the functions of temperature, *viz.*, $J_t = J_0 \Sigma W_m \cos I_m$ where W_m is the probability of precession at the angle I_m; if α be a parameter characterising some electric, magnetic or mechanical property of the metal at absolute zero, then the value of this parameter may be deduced at any temperature between absolute zero and the Curie point. It is shown how the method may be applied to the deduction of laws for the effect of temperature on the curves of magnetisation of crystals (parallel and normal components), magnetostriction, mechanostriction, thermomagnetic effect, influence of tension on magnetisation curves, Thomson effect and the galvanomagnetic effect. The demonstration of the truth of the principle of equivalence at low temperatures (enunciated by the author) is also possible. H. J. H. S.

***4702. Precise Magnetic Torque Measurements on Single Crystals of Iron. L. P. Tarasov and F. Bitter.** *Phys. Rev.* 52. *pp.* 353–360, *Aug.* 15, 1937.—An experimental arrangement is described for obtaining magnetic torque curves; it consists of a torque balance and rotating pole pieces. The theoretical treatment of the torque curves is discussed and a method is developed for predicting the orientation from a knowledge of the angles of zero torque alone. It appears that the use of cylindrical discs introduces errors which may be avoided by using ellipsoids. Experimental torque curves for a single crystal ellipsoid of 2·8% Si-Fe are described and a value for the first anisotropy constant of $1 \cdot 70 \times 10^5$ ergs per c.c. is found sufficient to account adequately for the experimental results. H. J. H. S.

4703. Magnetic After-Effects in Carbonyl Iron. G. Richter. *Ann. d. Physik*, 29. 7. *pp.* 605–635, *Aug.*, 1937.—It is shown that part of the magnetisation produced by a coil in a rod or ring of well annealed carbonyl iron does not disappear suddenly when the current is switched off. This effect is not due to eddy currents, because it is the same if the solid rod or ring is replaced by a laminated one. A theoretical calculation also shows that the effect of eddy currents ought to be negligible. The effect depends strongly on temperature, in the sense that an increase of 10° C. reduces the time scale of the after-effect by a factor of about 3·5. The time dependence of the remaining magnetisation is exponential over part of the range but less rapid both in the beginning and for very long times. If the field is switched on and off in succession, the individual after-effects are superimposed linearly, provided the fields are sufficiently small. R. P.

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4704. Magnetic Properties of Alloys of Iron with Ruthenium or Osmium. M. Fallot. *Comptes Rendus*, **205.** *pp.* **227–230,** *July* **19, 1937.**—The Curie points, θ, transformation points $\alpha \rightleftharpoons \gamma$, and magnetic moments, μ, were determined for alloys of Fe with Ru and Os containing up to 14 and 11% (atomic) respectively. θ decreases linearly at the rate of 16° and 11° per atom of Ru and Os respectively. The relations to changes in θ of the transformation points are discussed. These cover an increasing range of temperature as the percentage of Ru or Os increases. μ is constant if the content of Ru does not exceed 8%, and decreases slowly and linearly in the Os alloys up to 5% Os, and then in both cases drops rapidly. C. A. S.

4705. Magnetic Moments of Rare-Earth Kations. B. Cabrera. *Comptes Rendus*, **205.** *pp.* **400–403,** *Aug.* **23, 1937.**—An account is given of a long series of measurements on the magnetic moments of the kations Gd^{+++}, Dy^{+++}, Ho^{+++} and Er^{+++}. The results are tabulated and discussed and the most probable value of the magneton appears to be 1130 (in place of the usually accepted value of 1124·9), although it is suggested that the actual value depends a little on the paramagnetic family of the material examined. This value is below that given by theory (quantum value) and nearer, but a little above, that given by Weiss. H. J. H. S.

4706. Magnetic Properties of Iron Amalgams. L. F. Bates and P. F. Illsley. *Phys. Soc., Proc.* **49.** *pp.* **611–618,** *Sept.* **1, 1937.**—Amalgams of Fe and Hg have been prepared by electrolysis and the magnetic properties of the frozen amalgams investigated by the Gouy method. Only very minute quantities of Fe can possibly be absorbed before ferromagnetic properties are evident in the amalgams. The Fe behaves as if it possesses a specific magnetisation of 130 c.g.s. units instead of the 220 normally exhibited by pure Fe in bulk at the temperature of the experiments, − 78·5° C. With increasing Fe-content the paramagnetism of the amalgam, as distinct from the ferromagnetism of the Fe, also increases steadily, for which it is suggested that a combination of Fe and Hg is responsible. AUTHORS.

***4707. Discontinuous Change in Magnetisation in Ferromagnetic Substances. Part II. K. Murakawa.** *Phys. Math. Soc. Japan, Proc.* **19.** *pp.* **715–733,** *Aug.*, **1937.** *In English.*—The apparatus described in a previous communication [see Abstract 5293 (1936)] has been modified to eliminate disturbance due to tube noise in the amplifier and by the use of a Braun tube as well as an electromagnetic oscillograph as the voltage recording apparatus. The reversal process in Fe and Ni samples in the form of polycrystalline wires and single crystals is studied. The oscillograms show groups of peaks or a single peak. The peaks are caused by the propagation of reversal of magnetisation. The wave-form is discussed theoretically, and the formulæ derived fit the observed curves. C. J. B. C.

4708. Dispersion Band and Skin Effect in Sinusoidal and Transitional Fields. W. Arkadiew. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* **16. 1.** *pp.* **35–40, 1937.** *In French.*—The conditions obtaining in a constant field created instantaneously when, as a result of magnetic viscosity, only a part of the intensity of magnetisation appears whilst the remaining portion grows exponentially, is considered. The effect of a periodic change in the field is then examined and the process of penetration of the constant field in a ferromagnetic metal with magnetic viscosity and given electrical conductivity is discussed and calculations are performed on the influence of the skin effect in periodic, sinusoidal and transitional fields. It is pointed out that, in recording with the aid of an oscillograph the initial appearance of flux in a ferromagnetic cylinder in weak fields (*i.e.*, when μ is independent of H), a curve is obtained from which the magnetic spectrum of the ferromagnetic may be calculated. H. J. H. S.

4709. Atomic Moments and Curie Points in Solid Solutions of Nickel. V. Marian. *J. de Physique et le Radium*, 8. *pp.* 313–315, *July*, 1937.—When non-ferromagnetic elements are added to nickel the mean atomic moment (M) and the Curie point (Θ) decrease as the amount of metal added. The paper contrasts the types of curves obtained when M or Θ are plotted against the number of atoms (T) of added metal with those obtained when M or Θ are plotted against nT, where n is the number of valency electrons of the added metal. With the second method the curves are practically superposable and variations in M and in Θ are therefore dependent on the number of valency electrons. W. R. A.

4710. Diamagnetic Susceptibilities of Dissolved and Hydrated Salts. F. E. Hoare and G. W. Brindley. *Phys. Soc., Proc.* 49. *pp.* 619–628, *Sept.* 1, 1937.—From a wide survey of the available experimental data for the diamagnetic susceptibilities of salts in aqueous solution, the effective susceptibilities of the ions in solution are obtained and their additivity is established to within 1% of the observed values. There are shown to be systematic differences between the susceptibilities of ions in solution and in crystals. Small univalent ions and all bivalent ions have effectively smaller susceptibilities in solution than in crystal owing to the effect of the ions on the surrounding water molecules; this effect is correlated with the field at the boundary of the ions. Large univalent ions have effectively larger susceptibilities in solution than in crystals, owing mainly to the change in coordination of these ions when they are dissolved. New measurements are given of the susceptibilities of a number of hydrated salts. It is shown that the susceptibilities of salts obtained from results for hydrated crystals, by assuming the water of hydration to have the same susceptibility as ordinary water, approximate closely to the effective susceptibilties of salts in solution than to the true susceptibilities of the anhydrous salts. AUTHORS.

4711. Natural Magnetism of Crystals. F. Krüger and F. Brasack. *Ann. d. Physik*, 30. 2. *pp.* 113–135, *Sept.*, 1937.—Natural magnetism in crystals of certain crystal structure can be predicted and the various types of crystal structure are reviewed. A new method of measuring natural magnetism is described and results are given for two specimens of gypsum of different origin and containing about 0·00015% iron. The incompatibility of the existence of natural magnetism and diamagnetic permeability in gypsum is discussed. W. R. A.

4712. Electrodynamics of Material Media. H. Mandel and P. Kutejnikov. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 16. 2. *pp.* 83–85, 1937. *In German.*—Expressions for the electromagnetic tensors in anisotropic media are given. G. C. McV.

4713. Whittaker's Electromagnetic Scalar Potentials. H. S. Ruse. *Quarterly J. of Mathematics*, 8. *pp.* 148–160, *June*, 1937.—Whittaker's theorem on the scalar potentials from which the field of a moving electric charge can be calculated, is generalised to tensor form and shown to involve the use of the Hertzian tensor. G. C. McV.

4714. Behaviour of Bitter's Striations Under Elastic Excitation. T. Soller. *Zeits. f. Physik*, 106. 7–8. *pp.* 485–498, 1937.—Bitter's striations are the characteristic precipitates of γ-Fe_2O_3 particles on the polished surfaces of ferromagnetic single crystals. These have been prepared under different conditions, *e.g.*, drawing, pressure, and in a magnetic field. The results are shown in photographs and are discussed. W. R. A.

✱**4715. Relay for Maintaining Constancy of Magnet Currents. L. Leiterer.** *Phys. Zeits.* 38. *pp.* 626–627, *Aug.* 15, 1937.—Full details are given of a valve-controlled relay for maintaining the constancy of the p.d. across a magnet coil. The arrangement described is suitable for magnet currents up to 300 mA. and the system is capable of dealing with voltage fluctuations up to 5¼ V, although, by suitable adjustment, the range of the system may be greatly extended. H. J. H. S.

✱**4716. Design of Powerful Electromagnets. Part III. F. Bitter.** *Rev. Sci. Instruments*, 8. *pp.* 318–319, *Sept.*, 1937.—In a previous paper having the above title [see Abstract 386 (1937)], a numerical error was made in the calculations. This is corrected, and experimental results on a small ion magnet are described. AUTHOR.

See also Abstracts 4499, 4505.

MEDICAL RADIOLOGY AND ELECTROLOGY.

✱**4717. Electric Cardiometer. F. Henry.** *Science*, 85. *pp.* 229–230, *Sept.* 3, 1937.—Recording the heart beat by the usual pneumatic method is not entirely satisfactory, as slight bodily movements on the part of the patient cause variation, particularly in the study of the physiology of exercise, and strong psychological stimuli. Boas was the first to employ thermionic valves to record such pulsation. The author describes in detail an improved apparatus utilising multiple valves, offering advantages over the instrument used by Boas. B. J. L.

4718. Cardiography with Connections to the Extremities. U. Bab. *Zeits. f. Instrumentenk.* 57. *pp.* 364–370, *Sept.*, 1937.—In electro-cardiographic work the connections *via* the right and left arms and left leg, as originally proposed by Einthoven, give a useful form of electrocardiographic registration which is well defined and reproducible. No other type of connection permits of such useful results, having regard to the variations of conductivity of the human body. Utilising these methods of connection, by means of a commutator arrangement, the author has obtained rapid variation of the particular connections, with readings given in the form of polar diagrams. Examples are given of electrocardiographs obtained which permit, in a simple manner, extension of the usefulness of this method of investigation. B. J. L.

✱**4719. Planigraphy. J. R. Andrews and R. J. Stava.** *Am. J. of Roentgenology and Radium Therapy*, 38. *pp.* 145–151, *July*, 1937.—To obtain better X-ray images of a region in a depth of tissue, various methods of multiple exposure with different positions of the X-ray tube have been devised, and given the terms stratigraphy, planigraphy, and tomography. The authors analyse the methods geometrically and mathematically and describe an experimental tomographic apparatus. Results show that the stratigraphic method of Vallebona is defective, but the planigraphic method of Ziedses des Plantes and the tomographic method of Grossmann, offers a correct solution for the X-ray projection of the true image of a plane section of a solid object. The planigraphic method theoretically offers a better solution than the tomographic method, as all interfering parts in all directions are blurred by a circular or spiral motion of the apparatus, whereas the tomographic method only employs a linear movement. The mechanical problems of construction of the planigraphic method are greater than those of the tomographic method so that the latter offers mechanical advantages over the theoretical advantages of the planigraphic method. B. J. L.

*4720. **Stratigraphy. P. Ponthus and J. Malvoisin.** *J. de Radiologie et d'Électrologie*, 21. *pp*. 337–343, *Aug*., 1937.—The theory of a method of differentiating deeper structures in radiographs, termed stratigraphy, is discussed. An apparatus is illustrated and described which shows by analogy the method in respect to light rays. B. J. L.

4721. **Specification of Radiographic Technique. C. J. Zintheo, Jr.** *Am. J. of Roentgenology and Radium Therapy*, 38. *pp*. 352–362, *Aug*., 1937.—Radiographic techniques are not definitely defined in terms of distance of tube, time, and tube current and voltage. Many other factors enter into the question, as resistance drop in the primary leads, transformer design, type of rectification, etc., an extensive list of factors which may cause variation being given. The difficulty of determining the actual tube potential by various methods is discussed in respect to the limitations, leading to the conclusion that new units based upon actual X-ray tube output must be adopted before radiographic techniques can be standardised. Methods of measuring the quantity and quality output of X-ray tubes are discussed in respect to their usefulness and limitations and a satisfactory solution has yet to be obtained. B. J. L.

4722. **Detection of Shadows in Radiographs. A. E. Barclay and K. J. Franklin.** *Brit. J. of Radiology*, 10. *pp*. 689–692, *Sept*., 1937.—An X-ray film will record the presence of radio-opaque objects as small as 0·15 mm., even when lying at a distance of 4 in. from the film, provided that they are of sufficient difference in radio-opacity from the medium in which they lie. AUTHORS.

*4723. **Centralised Control for X-Ray Apparatus. P. D. Hay, Jr.** *Am. J. of Roentgenology and Radium Therapy*, 38. *pp*. 72–76, *July*, 1937.—In modern X-ray apparatus, all the controls are placed upon a single panel. The author has extended this method to permit a single h.v. generating apparatus to supply apparatus used for investigation in three different rooms, the advantage being claimed that the actual operation of such apparatus is brief in comparison with the time of positioning the patient, etc. This centralised control system consists of a selector switch, a robot for throwing the h.v. switch, a fluorographic unit, various magnetic triggers, exposure timing switches for Potter-Bucky apparatus and miliamperage control. The various units, described and illustrated in detail, have given satisfactory operation for three years. B. J. L.

4724. **Ionisation in Air by γ-Rays. G. Failla and L. D. Marinella.** *Am. J. of Roentgenology and Radium Therapy*, 38. *pp*. 312–343, *Aug*., 1937.—In measurement of γ-rays by ionisation in air, the authors have attempted, in the laboratory, to make measurements under conditions which would fulfil the definition of the roentgen. They have reached the conclusion it is extremely difficult to measure γ-rays in terms of roentgens, by any method, with the possible exception of the thimble chamber, this method being open to question, but the method of choice. The aim of a common unit of dosage for radium and X-rays is to co-relate tissue and biological effects in therapy, but practice shows that there is no relationship for equal dosage of these two types of radiation.

Experiments are described, in great detail, of measurements to determine γ-rays intensity, with varying types of ionisation apparatus. These show the roentgen should not be fixed as a unit of tissue dose, and an alternative unit, based on the number of ions produced per gm. of air at a given point in a given medium, is proposed. Adoption of this unit would necessitate a great deal of further research and the subject is considered to be still open in respect to determination of a suitable unit. B. J. L.

4725. Photoelectric Measurements in Radiotherapy at 200 to 400 kV. Denier. *J. de Radiologie et d'Électrolgie.* **21.** *pp.* **360–363,** *Aug.,* **1937.**—Photoelectric cells as used in X-ray dosimetry are investigated for h.v. X-rays, characteristic curves being given. The intensity of penetration is practically constant at 300 kV, and is about 37%. The sensibility of the cell is increased when placed at the centre of a phantom. Whilst the radiation absorbed at the centre of a phantom does not greatly vary in respect to quantity, variations occur in respect to variation of quality to a degree of 6% at 285 kV and 35% at 330 kV. Details are given particularly in respect to a Se cell due to Salaun. B. J. L.

4726. Dosage and Intensity of X-Rays. L. Graf. *Phys. Zeits.* **38.** *pp.* **610–618,** *Aug.* **15, 1937.**—This paper considers the question of the variation of dosage and intensity of X-rays with voltage, a problem which is at present becoming increasingly important owing to the introduction of h.v. X-ray tubes. For completely unfiltered white radiation the dosage varies as $V^{\frac{1}{2}}$ for voltages below 50 kV, as V for voltages between 50 and 200 kV, and as $V^{\frac{3}{2}}$ for voltages between 200 and 400 kV. The intensity also varies as $V^{\frac{2}{3}}$ for voltages between 150 and 400 kV, where V is the voltage applied to the tube. Calculations of intensity have been made according to the formula of Kramers, modified according to Bethe's formula for the stopping by the antikathode of electrons of all possible velocities. For h.v. tubes partial filtration—in the antikathode itself and the walls of the tube—takes place, and the variation of dosage with voltage depends on the particular type of tube. G. G.

4727. Radiation Dosimetry. L. H. Gray. *Brit. J. of Radiology,* **10.** *pp.* **600–612,** *Aug.,* **1937.**—An attempt to translate ionisation measurements of h.f. radiation into absolute measurements. In a cavity in a homogeneous absorbing medium, the atmosphere of secondary electrons crossing the cavity has been shown by Bragg to be in all respects identical with that which would exist in the absence of the cavity, and the measured ionisation in the cavity is therefore related in a simple manner to the energy absorbed in the surrounding medium. The details and full significance of this relationship are discussed, in detail, and it is concluded that absolute energy measurements may be made to an accuracy of about 5%. By such calculations, the energy of γ-rays has been found to be $8 \cdot 7 \pm 0 \cdot 2$ cal./gm. hr. as against $89 \pm 0 \cdot 2$ cal./gm. hr. found by direct calorimetry. G. E. B.

4728. Biological Effects of Continuous γ-Irradiation. S. Russ and G. M. Scott. *Brit. J. of Radiology,* **10.** *pp.* **619–628,** *Disc.,* **628–629, 1937.**—Describes experiments on the fertilities of rats irradiated continuously with γ-rays of dosage rates above 66, 11 and $2 \cdot 3$ times the accepted safe tolerance dosage-rate of 10^{-5} r./sec. The results showed that even at the lowest intensities used, the weights and fertilities of the rats were lower than those of the controls. G. E. B.

See also Abstracts **4483, 4637.**

OSCILLATIONS AND WAVES.

***4729. Source of Variable Rectangular Current Pulses. H. B. Peugnet.** *Rev. Sci. Instruments*, 8. *pp.* 340–342, *Sept.*, 1937.—A device is described for the production of rectangular current pulses of variable strength and duration, which does not require the use of mechanical timing accessories. AUTHOR.

4730. Diffraction of Electromagnetic Waves. V. D. Kupradze. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 16. 1. *pp.* 31–34, 1937. *In German.*—It is shown that the general problem of the diffraction of an electromagnetic wave by an obstacle of any shape but having a sufficiently regular bounding surface can be reduced to the solution of a Fredholm's integral equation of the second kind. This is known to possess a unique solution and the customary methods for obtaining approximate solutions of such equations can be applied. W. S. S.

4731. Ionising Agents in the Upper Atmosphere. I. Ranzi. *N. Cimento*, 14. *pp.* 145–170, *April*, 1937.—Having demonstrated mathematically a satisfactory explanation of the ionisation in the C-, D-, E_1-, E_2- and F_1- regions of the upper atmosphere, an attempt is made to explain the heavy ionisation found experimentally in the F_2- region. Using various data including that obtained during the solar eclipse of 1936, it is considered that the agent responsible for the F_2-region is an electronic radiation of solar origin which is bent by the earth's magnetic field and is, therefore, operative to some extent in shadow inaccessible to radiation of the ordinary u.v. type. F. C. C.

4732. Ionisation in the Ionosphere. Irène Mihul and C. Mihul. *Comptes Rendus*, 205. *pp.* 363–365, *Aug.* 9, 1937.—In frequency change experiments the reflected wave is obtained first from the E-layer and then from the F-layer. In temperate latitudes this transition, at the so-called critical frequency is sharp, but in tropical latitudes the change is more prolonged, the F-signal coming in before the E-signal has disappeared, the one gaining in intensity whilst the other decreases. There are also differences in the heights of the layer in the tropics and in the temperate zone. The ordinary explanation of the mechanism of reflection does not account easily for the co-existence of the two reflected rays. The authors propose an explanation which they claim will cover all these facts and which is based on the variation of the ionising action of the sun with latitude. A brief explanation of the working out of this theory is given. G. G.

4733. Sunspot Activity and Wireless Reception in 1936. J. H. C. Lisman. *Tijds. Nederland. Radiogenootschap*, 7. *pp.* 142–148, *July*, 1937.—The experience of two Dutch wireless stations (Kootwijk and Noordwijk) communicating on short waves with North America and the Dutch East Indies is analysed and compared with the variation of sunspot activity over the same time. At present the slow variation of the sunspot activity (period 11 years) consists of an increase and it is a common experience that the most suitable wave-length for long distance transmission is smaller when there are fewer sunspots. These stations found it indeed necessary to reduce their wave-length gradually during the last few years. Data are also given for the short-time fading (Dellinger effect) during 1937. No very obvious correlation with the days of high sunspot activity was found, although the Dellinger effect was definitely more frequent than in the previous years of lower activity. Sometimes the times of the Dellinger effect coincided with the beginning of a new eruption on the sun, and there are also such coincidences with magnetic disturbances, but more statistical material is required before definite conclusions can be drawn. R. P.

4734. Nature of Atmospherics. Part V. R. A. W. Watt, J. F. Herd and F. E. Lutkin. *Roy. Soc., Proc.* 162*A*. *pp*. 267–291, *Sept.* 15, 1937.—The results of eye-and-hand delineations of atmospheric wave forms observed in the Red Sea and Indian Ocean, Egypt, the Anglo-Egyptian Sudan and in "control" observations in south-east England are presented in tabular form. Photographic recording of wave form and of apparent direction of arrival at the two ends of a 560 km. base-line reveals the details of the dispersive process by which the higher frequency components, travelling with a higher group velocity and subject to heavier attenuation than the lower frequency components, form, at distances over some 500 km., a discrete oscillatory component preceding and completely detached from a slow form of the type delineated by the eye-and-hand method. The principal characteristics of the resulting dual wave form are plotted against distance over ranges up to 4000 km. The oscillatory component is shown to contain prominent frequencies of the order of 5–20 kc./sec., and to have peak amplitudes falling from 500 mV/m. at 100 km. to 25 mV/m. at 4000 km. The slow form, with peak amplitudes of 125 mV/m. at 100 km. and 10 mV/m. at 4000 km. has a first "half-cycle" whose duration lies between 1·5 and 2·5 msec. in the first few hundred kilometres and rises to 6 msec. at 400 km. Some of the complexities in the factors controlling relative amplitudes and structure at the two ends of the base-line are briefly indicated. The occurrence of a "precursor" of small amplitude, comprising still higher frequency components, and approximately a millisecond in advance of the main oscillatory component, is provisionally associated with the discontinuities in the leader stroke identified by Schonland, Malan and Collens. [For Part IV see Abstract 938 (1937).] AUTHORS.

See also Abstracts 4412, 4673, 4697.

PHOTOELECTRICITY.

4735. Effect of Temperature on Photoelectric Emission. R. J. Cashman. *Phys. Rev.* 52. *pp*. 512–518, *Sept.* 1, 1937.—A survey of the existing theories of photoelectric emission near the threshold shows that for $\nu \ll \nu_0$, $I = \text{const.}\ T^n \varepsilon^{h(\nu-\nu_0)/kT}$ and for $\nu = \nu_0$, $I = \text{const.}\ T^n$. Different theories demand values of n from $\frac{1}{2}$ to $\frac{5}{2}$. By taking data at the threshold for different temperatures an analysis of the existing photoelectric data shows that n lies between 0·7 and 1·7 for different elements. The apparent departure from a T^2 law can be adequately explained if it is assumed that the work-function increases with temperature. Two methods, which are in agreement, are suggested for determining temperature coefficients, one depending on data taken at the threshold, the other on data taken at the point of intersection of the spectral sensitivity curves at different temperatures. The value of the constant A in Richardson's thermionic equation is computed on the hypothesis that for a clean metal the departure from the theoretical value is due to a temperature coefficient of the work function and excellent agreement with experiment is obtained. D. H. F.

4736. Angular Distribution of Photoelectrons from the K Shell. F. F. H. Eggleston and L. H. Martin. *Roy. Soc., Proc.* 162*A*. *pp*. 95–110, *Sept.* 1, 1937.—The longitudinal angular distribution of X-ray photoelectrons from the K shell of A is investigated with the Wilson cloud expansion chamber. A graphical method is employed in the computation of angles of ejection which combines the advantages of simplicity and accuracy. A survey of existing data is made and the discrepancies of this with quantum theory are discussed. The distribution curves, bipartition angles and asymmetries for photoelectron energies of 14·2, 46·8 and 88·2 ekV have been obtained, and are found to be in excellent agreement with the predictions of wave mechanics. AUTHORS.

*4737. **Photo-Cells with Secondary Emission Electrodes. W. Kluge, O. Beyer and H. Steyskal.** *Zeits. f. techn. Physik*, 18. 8. *pp.* 219–228, 1937.—Describes the principle of the multiplication of photoelectric currents by the use of secondary emission electrodes. A comparison is made of magnetic and electrostatic means of focusing the electron beam and a commercial unit of the latter type is described. Its behaviour is discussed from the points of view of the lower limit of intensity to which it is applicable, the variation of the multiplication with applied voltage, and its constancy with time. A two-stage form is described in which no focusing of the electron beam is employed, similar in appearance to an ordinary gas-filled photo-cell (actually only 6 cm. in overall length.) D. H. F.

4738. Photoconducting Effect in Thin Metallic Films. T. Fukuroi. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 721, *pp.* 187–195, *Aug.*, 1937. *In English.*—The increase of the photoconductivity of Hg, Cd and Zn films condensed on the surface of glass or quartz at liquid-air temperature, when exposed to u.v. rays, is measured. When the film is of a certain thickness the efficiency of photoconduction is a maximum, whereas when the layer becomes thicker it diminishes. The threshold wave-length of the effect is the same as that of the external photoelectric effect. Upon comparing these results with those obtained by Roller and his co-workers [see Abstract 4299 (1931)], it is possible to conclude that the metal deposit is composed of a number of isolated metallic granules and the photoelectrons emitted from them under the illumination of u.v. rays move along the surface of the substratum under the potential gradient, the result being the increase in electric conductivity. AUTHOR.

*4739. **Selenium Rectifier Photo-Cells. L. Bergmann and R. Pelz.** *Zeits. f. techn. Physik*, 18. 7. *pp.* 177–191, 1937.—Specimens of two types of Se rectifier cells (referred to as H and K types) made by the same maker were exposed, short-circuited, to intensities up to 4500 lux for 24 days. The photo-e.m.f. increased by 10–20% over this period, the increase being rather greater for the type with the higher resistance (H type), but the short-circuit photo-current increased by only 2–4%. In the temperature range − 180° to + 100° maxima for the photo-e.m.f. were found at − 50° and − 25° for types K and H respectively. Over the practical range of temperature − 20° to + 30° the temperature coefficient of the photo-e.m.f. is − ·003, and for the short-circuit photo-current is + ·001. The variation of the resistance of the blocking-layer with temperature in both directions was investigated. Both the photo-current and photo-e.m.f. were found to increase when the illuminated area was decreased, the total illumination being kept constant, but the effect varies with wave-length and is different for the two types. The lag in the building up of the photo-current on illumination was found to vary with the wave-length of the incident light, with its intensity, with temperature and with the area of surface illuminated. D. H. F.

***4740. Nature of Blocking-Layer in Selenium Rectifier Photo-Cell. P. Görlich.** *Zeits. f. Physik*, 106. 5–6. *pp.* 373–378, 1937.—It was found that the deposition of the electrode by kathode sputtering resulted in more sensitive cells than when the evaporation process was employed. Further experiments indicated that oxides of Se and adsorbed gas atoms are present on the Se in thin films or in patches. The thickness of the metallic electrode for which the sensitivity is a maximum is greater for cells in which the annealing of the Se has been done in N_2 than for those annealed in air. D. H. F.

***4741. Blocking-Layer and Hallwachs Photoelectric Effects. E. Perucca and R. Deaglio.** *Accad. Sci. Torino, Atti*, 72. *Disp.* 3*a. pp.* 500–508, *April–Oct.*, 1937.—The dependence of the e.m.f. of saturation of a photo-cell (with Cu or Se) is expressed as a function of the frequency of the exciting light. This dependence is linear according to the theory of Perucca and Deaglio which connects the photo-effect of the blocking-layer with the Hallwachs effect. The gradient of the straight line is not in accordance with the relation of Einstein. The probable cause of this divergence is discussed. J. J. S.

***4742. Compensating Circuit for Blocking-Layer Photoelectric Cells. B. A. Brice.** *Rev. Sci. Instruments*, 8. *pp.* 279–285, *Aug.*, 1937.—A compensating circuit comprising two blocking-layer photo-cells in a parallel connection with a galvanometer and potentiometer-rheostat is described. Analysis of the circuit shows that a uniform scale attached to the potentiometer-rheostat may be used to indicate transmission (or reflectance) of light by a sample if the resistance of the potentiometer and the series internal resistances of the photo-cells are small in comparison with the parallel internal resistances of the photo-cells. The performance of the circuit under different conditions was tested by means of wire screens of known transmission. With moderate illumination on the photo-cells and using a 50-ohm potentiometer-rheostat carrying a scale graduated from 0 to 100, errors in indicating transmission are believed to be not greater than ± 0·1 on this scale. AUTHOR.

4743. Standardisation of Photo-Cells by Solar Radiation. A. Angström. *Gerlands Beitr. z. Geophys.* 50. 2–4. *pp.* 176–183, 1937. *Julius Maurer Festschrift. In English.*—Cells are used whose chief sensitivity lies in the visible spectrum. The energy distribution depends on the turbidity coefficient, β, of the atmosphere. β is found by a graphical method from actinometric measurements using the absorption of water vapour for various masses of air and the pressure of water vapour. The intensity of radiation over a range of wave-lengths is compared with the galvanometer deflection to get the constant, k, of the cell. For accuracy greater than 2% the measurements must be repeated in different conditions and hazy or variable weather avoided. Variation of solar intensity is not allowed for. R. S. R.

4744. Calibration of Photo-Cells by Measurement of Solar Radiation. O. Hoelper. *Gerlands. Beitr. z. Geophys.* 50. 2–4. *pp.* 330–337, 1937. *Julius Maurer Festschrift.*—If the sensitivity curve of a photo-cell is known, it is possible to find the terrestrial energy spectrum from the photo-current by considering the atmospheric absorption. The radiation integral can be obtained in cal./cm^2. between arbitrary spectrum limits for definite absorption coefficients. Combining this integral with the photo-current measured under these conditions, the cell is standardised in absolute units. Measurements with two cells made on certain days were examined and showed that one cell gave accurate results for a certain region of the spectrum, while the other required suitable filtering. [See also Abstract 5316 (1936).] H. M. B.

4745. Electrical Effect of Light on Metallic Films. Q. Majorana. *Phys. Zeits.* 38. *pp.* 663–667, *Sept.* 1, 1937.—Further experiments were carried out on the increase in resistance produced in thin metal films when illuminated [see Abstract 4750 (1934)]. Gold foils 0·08–1·5 μ thick and kathode-sputtered films up to 4 μ in thickness were illuminated by a pulsating beam at frequencies 600 and 1200~, and the phase of the electrical effect relative to the light pulsation was studied. The phase varied from 45° to 60° over the range of thicknesses covered. Under illumination by a filament lamp the phase shift is a little greater for thicknesses below 0·7 μ than when a Hg-vapour lamp was used, but for greater thicknesses there was no difference. The phase shift to be expected if the effect is purely thermal in origin is calculated and found to have the same trend as the observed values, but the author considers that the experimental uncertainties do not account for the difference. D. H. F.

See also Abstracts 4658, 4682, 4725.

THERMIONICS.

4746. Theory of Shot Effect. E. N. Rowland. *Cambridge Phil. Soc., Proc.* 33. *pp.* 344–358, *July*, 1937.—A previous report [see Abstract 495 (1937)] is extended to the case of the shot effect when the anode circuit has inductance as well as resistance and capacity, and to the case of finite valve resistance with and without secondary emission. A detailed mathematical treatment is presented. N. M. B.

4747. Visual Observations on the Malter Effect. L. R. Koller and R. P. Johnson. *Phys. Rev.* 52. *pp.* 519–523, *Sept.* 1, 1937.—The thin film field emission (Malter effect) [see Abstract 4422 (1936)] from Al_2O_3 films on Al was investigated (*a*) by coating the film with a fine dust of willemite and observing the behaviour of the primary beam; (*b*) by forming an electron image of the surface by means of the Malter current from it. The behaviour of these films, while exhibiting the Malter effect, may be summarised as follows: (1) The potential of the front surface of the electrode is a saw-tooth function of time in any point, and non-uniform over the surface at any instant. (2) The current density of the primary beam at the surface varies, correspondingly, because of the varying electric field above the surface. (3) A time lag exists between the application of voltage across the film and the establishment of the Malter. (4) The Malter current issues chiefly from a number of isolated points on the surface, and the current from any one of these points varies with time. (5) The emitting points are scattered over the entire surface of the electrode, with some preferential grouping in the region covered by the primary beam. (6) Some of the electrons constituting the Malter current have a kinetic energy corresponding in order of magnitude to the voltage drop across the film. (7) The Malter electrons leave the film with a wide range of speeds. AUTHORS.

See also Abstracts 4234, 4235, 4695, 4735.